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LOCKHEED

TITLE

QUALIFICATION TEST OF HIGH PRESSURE ENGINE VALVE
3200 AND 6500 PSIG

SUBMITTED UNDER

AF 04(647)-97

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MISSILE SYSTEMS DIVISION
VAN NUYS, CALIFORNIA

REPORT NO. LMSD/902010

DATED October 17, 1960

LOCKHEED AIRCRAFT CORPORATION

MISSILE SYSTEMS DIVISION
VAN NUYS, CALIFORNIA

TITLE

EVALUATION TEST OF HIGH PRESSURE RELIEF VALVES

3200 AND 6500 PSIG

SUBMITTED UNDER

AF 04(647)-97

MODEL XA REFERENCE JD-590806 TA 3069

PREPARED BY J. O. Martin for D. R. Ehrlich GROUP Fluid Dynamics

CHECKED BY H. R. Smith APPROVED BY J. R. Steinbacher, Manager Van Nuys Test Services

NO. PAGES _____ NO PICTURES _____

NO DRAWINGS 13

REVISIONS

DATE	REV. BY	PAGES AFFECTED	REMARKS

FORM MSD 493

OBJECTIVE

The purpose of this test was to evaluate and compare several high pressure relief valves from various manufacturers in order to determine which parts were acceptable for helium service and weapon system usage.

CONCLUSION

None of the valves satisfied all of the test specifications principally because of leakage and/or poor functional performance at 160°F or 0°F (valve body temperatures). However, the valves from two manufacturers, namely Fluid Mechanics and Anderson Greenwood and Co., were superior in comparison to the other valves which were tested.

SUMMARY

It was originally intended that each valve be subjected to functional performance tests before, during, and after temperature, cycle, vibration, shock and corrosion tests. However, all of the valves were sensitive to temperature to some degree and either leaked and/or changed set pressure at 160°F or 0°F (valve body temperature). Therefore, most of the test time was devoted to repairing and/or readjusting each valve and repeating the temperature tests in an effort to correct the temperature deficiencies. Consequently, all valves were subjected to the temperature test, four were subjected to the cycle test, one was subjected to the vibration test, and none were subjected to shock or corrosion tests.

TEST SPECIMENS

The test specimens were high pressure relief valves supplied by five manufacturers. The valves were identified as indicated in Table I.

TABLE I. TEST SPECIMENS

MANUFACTURER AND LOCATION	PART NUMBER	SERIAL NUMBER	SET PRESSURE	SEAT MATERIAL
Anderson Greenwood and Co. Houston, Texas	3JS46-4	4180	3200	Buna-N or
	3JS46-3	4179	6500	Viton-A
Fluid Mechanics Houston, Texas	44-TG-8-SP	498	3500	Kel-F, Nylon
	44-TG-8-SP	497	6500	or Teflon
W.R. Ladewig Co. Los Angeles, California	154S	B59	3200	Kel-F
	154S	C59	3200	
	154S	C59	3200	
Vacco Valve Co. Los Angeles, California	RV90-4P-403	-	3200	Nylon
Vinson Manufacturing Co. Van Nuys, California	A-80040	1003	3200	Kel-F and
	A-90157-1	1001	3200	Buna-N or
	A-90157-2	1002	6500	Viton-A

Photographs of the test specimens are presented in Figures 1 through 5.

These valves are intended to be used as safety relief valves to protect appropriate ground service equipment (such as the mobile high pressure helium gas supply system) from over pressure resulting from thermal expansion of the compressed gas or failure of regulators or shut-off valves. It was considered desirable to procure relief valves with minimum differential between cracking and reseating pressures in order to minimize gas loss due to blow-down action.

Referring again to Table I, those valves with Teflon, Kel-F or Viton-A seals should be satisfactory in applications where occasional exposure to IRFNA fumes is unavoidable whereas the valves with Buna-N or nylon seals would be unsatisfactory unless adequately protected from such fumes.

The following specifications are reproduced from the references.

a. TABLE II. RELIEF VALVE SPECIFICATIONS

Valve Set Pressure (PSIG)	Proof Pressure (PSIG)	Cracking Pressure (PSIG)	Reseating Pressure (PSIG)
3200	4,500 ± 100	3200 ± 25	3100 Min.
6500	10,000 ± 100	6500 ± 100	6300 Min.

b. Zero leakage is required up to 98% of cracking pressure.

c. Zero leakage is required below the minimum reseat pressure.

TEST EQUIPMENT AND INSTRUMENTATION

The following equipment and instrumentation were utilized during these tests.

1. Regulated helium supply system.
2. Grieve-Hendry oven, +100 to +550°F.
3. Temperature chamber, -40 to +40°F (fabricated at LMSD for this test).
4. Calidyne shaker, 5000 force pounds (LMSD 20467).
5. Calidyne shaker control console (LMSD 24508).
6. Miscellaneous pressure gages, valves, fittings, etc.

DEFINITIONS

1. A functional performance test consisted of several actuation cycles performed in succession (usually 10 actuation cycles).
2. An actuation cycle consisted of the following:
   a. The inlet pressure to the specimen was increased until the first indication of continuous flow, of any magnitude, through the specimen was observed. This was recorded as cracking pressure.

b. The inlet pressure was then increased slightly so that rapid flow through the specimen was achieved for approximately one second.

c. The inlet pressure was then reduced until flow through the specimen ceased entirely (zero leakage). This was recorded as reseating pressure.

d. The inlet pressure was then reduced to working pressure (3000 or 6000 psig) or at least 100 psi below reseat pressure.

PROCEDURE

The procedures described in Section I through VII below were generally followed in order during the test program. All specimens were inspected (Section I) and subjected to Temperature Test #1 (Section II). Only those specimens which functioned properly at room temperature after completion of Temperature Test #1 were subjected to the remainder of the test program. Any specimens which malfunctioned during the temperature test were repaired and/or reworked either by LMSD or the manufacturer and then retested. Helium gas was used for all tests where pressure was applied.

I. Inspection

Each specimen was visually inspected for evidence of damage, defects and contaminants. The specimens were not disassembled for this inspection.

II. Temperature Test #1

Each specimen was functionally tested at each of the following stabilized valve body temperatures in the order listed.

a. Room temperature

b. 160°F

c. Room temperature

d. 0°F

III. Cycle Test #1

The specimens which functioned satisfactorily after completion of the temperature test were subjected to a cycle test consisting of 500[1] actuation cycles performed in succession at room temperature. Cracking and reseating pressures were recorded during each cycle.

1. T.A. 3089 originally specified 500 cycles and was later reduced to 50 cycles.

IV. Temperature Test #2

The temperature test was repeated exactly as described in Section II.

V. Vibration Test

The 3200 psig Anderson Greenwood relief valve was subjected to vibration of 5 to 20 cps at 0.4 inch double amplitude and 20 to 2000 cps at 10 g. Vibration was applied (1) parallel to the axis of the poppet and spring, and (2) perpendicular to the axis of the poppet and spring. Inlet pressure to the valve was maintained at 3000 psig and leakage from the outlet port was monitored during vibration. The frequencies at which leakage occurred were recorded.

VI. Cycle Test #2

A second cycle test of 500 actuation cycles was then executed at room temperature. Cracking and reseating pressures were recorded during each cycle.

VII. Temperature Test #3

A final temperature test was then accomplished as described in Section II.

RESULTS

The results of the tests described above are presented in the following tabulation. An asterisk appended to a cracking pressure value in the following text indicates "pop" pressure, i.e., approximate wide open pressure.

[illegible] CO., 3200 PSIG RELIEF VALVE, TYPE [illegible]
SERIAL NUMBER 4180

I. INSPECTION RESULTS

Visual inspection of this valve revealed no evidence of external damage, defects and contaminants.

II. TEMPERATURE TEST RESULTS

TEST CONDITION	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	TEST CONDITION	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)
I.a. Room temperature operation (70°F) as received.	3090	3050	I.c. Room temperature operation (70°F). (Valve stabilized at room temperature after exposure at 160°F.)	3040	--
	3090	Leaked[2]		3050	3030
	3080	2900		3050	3030
	3080	3050		3050	3030
	3080	3040		3050	3040
	3070	3040		3050	3040
	3070	3050		3050	3040
	3070	3050		3050	3030
	3060	3050		3050	3030
	3070	3050		3050	3030
	3050	3050		3040*	3000
	3070	3050		3040*	3020
	3080*	2900		3040*	3010
	3080*	3050			
I.b. Operation at 160°F. (The valve was heated to 160°F in a temperature chamber and then removed and tested immediately.)	3050	2990	I.d. Operation at 0 F. (The valve was cooled to 0 F in a temperature chamber, and then removed and tested immediately.)	Valve leaked excessively at 100 psig.	
	3040	3010			
	3040	3020			
	3040	3020			
	3040	3010			
	3040	3030			
	3040	3020			
	3030	3020			
	3030	3020			
	3030	3010			
	3030	3020			
	3000*	2700			
	3010*	2930			
	3010*	2890			
	3010*	2970			
	3010*	2950			
	3040	3010			

2. Valve leaked excessively, therefore it was disassembled and inspected. Approximately 8 tiny steel chips were found on the poppet O-ring seal. The valve was cleaned and reassembled and testing was continued.

* Indicates "pop" pressure (approximate wide open pressure).

NOTE: Helium gas was used for all test.

[illegible] GREENWOOD AND COMPANY, [illegible] PSIG RELIEF VALVE, TYPE [illegible]
SERIAL NO. [illegible]

III. CYCLE TEST RESULTS

CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)
3050 psig	2875 psig	3050 psig	3000 psig	[illegible] psig	3000 psig	3050 psig	3000 psig
3050	[illegible]	3050	3000	[illegible]	3000	3050	3000
3050	[illegible]	3050	3000	[illegible]	3000	3050	3000
3050	[illegible]	3050	3000	[illegible]	3000	3050	3000
3050	[illegible]	3050	3000	[illegible]	[illegible]	3050	3000
3050	[illegible]	3050	3000	[illegible]	3000	3050	3000
3050	[illegible]	3050	3000	3050	3000	3050	3000
3050	[illegible]	3050	3000	[illegible]	3000	3050	3000
3050	[illegible]	3050	3000	[illegible]	3000	3050	3000
3050	[illegible]	3050	3000	3050	2950	3050	3000
3050	[illegible]	3050	3000	[illegible]	[illegible]	3050	3000
3050	[illegible]	[illegible]	3000	[illegible]	3000	3050	3000
3050	[illegible]	[illegible]	2950	[illegible]	[illegible]	3050	3000
3050	[illegible]	3050	2950	[illegible]	[illegible]	3050	3000
3050	[illegible]	3050	3000	[illegible]	[illegible]	3050	3000
3050	[illegible]	3050	3000	[illegible]	[illegible]	3050	3000
3050	2990	3050	3000	[illegible]	3000	3050	3000
3050	2990	3050	3000	[illegible]	3000	3050	3000
3050	3000	3050	2950	3050	3000	3050	3000
3050	3000	3050	2990	3050	3000	3050	3000
3050	3000	3050	2990	3050	3000	3050	3000
3050	3000	3050	3000	3050	3000	3050	3000
3050	3000	3050	3000	3050	3000	3050	3000
3050	2950	3050	3000	3050	3000	3050	2950
3050	2980	3050	3000	3050	3000	3050	2990
3050	3000	3050	3000	3050	3000	3050	2990
3050	3000	3050	3000	3050	3000	3050	2970
3050	3000	3050	3000	3050	3000	3050	3000
3050	3000	3050	3000	3050	3000	3050	3000
3050	3000	3050	3000	3050	3000	3050	3000
3050	3000	3050	3000	3050	3000	3050	3000
3050	2950	3050	3000	3050	3000	3050	3000
3050	3000	3050	3000	3050	3000	3050	3000
3050	3000	3050	3060	3050	3000	3050	3000
3050	3000	3050	3000	3050	3000	3050	3000
3050	3000	3050	3000	3050	3000	3050	3000
3050	3000	3050	3000	3050	3000	3050	3000
3050	3000	3050	3000	3050	3000	3050	3000
3050	3000	3050	3000	3050	3000	3050	3000
3050	3000	3050	2990	3050	3000	3050	3000
3050	3000	3050	2990	3050	3000	3050	3000
3050	3000	3050	2990	3050	3000	3050	3000
3050	3000	3050	2990	3050	3000	3050	3000
3050	3000	3050	2990	3050	3000	3050	3000
3050	3000	3050	2990	3050	3000	3050	3000
3050	3000	3050	2990	3050	3000	3050	3000
3050	3000	3050	2990	3050	3000	3050	3000
3050	3000	3050	2990	3050	3000	3050	3000
3050	3000	3050	3000	3050	3000	3050	3000
3050	3000	3050	3000	3050	3000	3050	3000

[illegible] AIRCRAFT CORPORATION

[illegible]

REPORT L[illegible]/909010

[illegible] GREENWOOD AND COMPANY, 3200 PSIG RELIEF VALVE, TYPE 3[illegible]46-[illegible]
SERIAL NO. [illegible]

III. CYCLE TEST RESULTS

CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)
3050 psig	2950 psig	3200 psig	3190 psig	3200 psig	3190 psig	3200psig	3190
3050	2950	3200	3190	3200	3190	3200	3190
3050	2950	3200	3190	3200	3190	3200	3190
3050	2990	3200	3190	3200	3190	3200	3190
3050	2950	3200	3190	3200	3190	3200	3190
3050	2950	3200	3190	3200	3190	3200	3190
3050	2950	3200	3190	3200	3190	3200	3190
3050	2950	3200	3190	3200	3190	3200	3190
3050	2950	3200	3190	3200	3190	3200	3190
3050	2950	3200	3190	3200	3190	3200	3190
3050	2990	3200	3190	3200	3190	3200	3190
3050	2990	3200	3190	3200	3190	3200	3190
3050	2990	3200	3190	3200	3190	3200	3190
3050	2990	3200	3190	3200	3190	3200	3190
3050	2990	3200	3190	3200	3190	3200	3190
3050	2990	3200	3190	3200	3190	3200	3190
3050	2990	3200	3190	3200	3190	3200	3190
3050	3000	3200	3190	3200	3190	3200	3190
3050	3000	3200	3190	3200	3190	3200	3190
3050	3000	3200	3190	3200	3190	3200	3190
3050	3000	3200	3190	3200	3190	3200	3190
3050	3000	3200	3190	3200	3190	3200	3190
3050	3000	3200	3190	3200	3190	3200	3190
3050	3000	3200	3190	3200	3190	3200	3190
3050	3000	3200	3190	3200	3190	3200	3190
3050	3000	3200	3190	3200	3190	3200	3190
3050	3000	3200	3190	3200	3190	3200	3190
3050	3000	3200	3190	3200	3190	3200	3190
3050	3000	3200	3190	3200	3190	3200	3190
3050	3000	3200	3190	3200	3190	3200	3190
3050	3000	3200	3190	3200	3190	3200	3190
3050	3000	3200	3190	3200	3190	3200	3190
VALVE RESET TO 3200		3200	3190	3200	3190	3200	3190
PSIG		3200	3190	3200	3190	3200	3190
3200	3190	3200	3190	3200	3190	3200	3190
3200	3190	3200	3190	3200	3190	3200	3190
3200	3190	3200	3190	3200	3190	3200	3190
3200	3180	3200	3190	3200	3190	3200	3190
3200	3190	3200	3190	3200	3190	3200	3190
3200	3190	3200	3190	3200	3190	3200	3190
3200	3190	3200	3190	3200	3190	3200	3190
3200	3190	3200	3190	3200	3190	3200	3190
3200	3190	3200	3190	3200	3190	3200	3190
3200	3190	3200	3190	3200	3190	3200	3190
3200	3190	3200	3190	3200	3190	3200	3190
3200	3190	3200	3190	3200	3190	3200	3190
3200	3190	3200	3190	3200	3190	3200	3190
3200	3190	3200	3190	3200	3190	3200	3190
3200	3190	3200	3190	3200	3190	3200	3190
3200	3190	3200	3190	3200	3190	3200	3190

[illegible] AIRCRAFT CORPORATION

REPORT [illegible]

[illegible] CREENWOOD AND COMPANY, 3200 PSIG RELIEF VALVE, TYPE 3[illegible]
SERIAL NO. 4260

III. CYCLE TEST RESULTS

CYCLE NO.	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)
[illegible] psig	3190 psig	[illegible]200 psig	3180 psig	3200 psig	3180 psig		
2	3190	3200	3180	3200	3180		
3	3190	3200	3180	3200	3180		
4	3190	3200	3180	3200	3180		
5	3190	3200	3180	3200	3180		
6	3190	3200	3180	3200	3180		
7	3190	3200	3180	3200	3180		
8	3190	3200	3180				
9	3190	3200	3180				
10	3190	3200	3180				
11	3190	3200	3180				
12	3190	3200	3180				
13	3190	3200	3180				
14	3190	3200	3180				
15	3190	3200	3180				
16	3190	3200	3180				
17	3190	3200	3180				
18	3190	3200	3180				
19	3190	3200	3180				
20	3190	3200	3180				
21	3190	3200	3180				
22	3190	3200	3180				
23	3190	3200	3180				
24	3190	3200	3180				
25	3190	3200	3180				
26	3190	3200	3180				
27	3190	3200	3180				
28	3190	3200	3180				
29	3190	3200	3180				
30	3190	3200	3180				
31	3190	3200	3180				
32	3190	3200	3180				
33	3190	3200	3180				
34	3190	3200	3180				
35	3190	3200	3180				
36	3190	3200	3180				
37	3190	3200	3180				
38	3190	3200	3180				
39	3190	3200	3180				
40	3190	3200	3180				
41	3190	3200	3180				
42	3190	3200	3180				
43	3190	3200	3180				
44	3190	3200	3180				
45	3190	3200	3180				
46	3190	3200	3180				
47	3190	3200	3180				
48	3190	3200	3180				
49	3190	3200	3180				
50	3190	3200	3180				
51	3190	3200	3180				
52	3190	3200	3180				
53	3190	3200	3180				
54	3190	3200	3180				
55	3190	3200	3180				
56	3190	3200	3180				
57	3190	3200	3180				
58	3190	3200	3180				
59	3190	3200	3180				
60	3190	3200	3180				
61	3190	3200	3180				
62	3190	3200	3180				
63	3190	3200	3180				
64	3190	3200	3180				
65	3190	3200	3180				
66	3190	3200	3180				
67	3190	3200	3180				
68	3190	3200	3180				
69	3190	3200	3180				
70	3190	3200	3180				
71	3190	3200	3180				
72	3190	3200	3180				
73	3190	3200	3180				
74	3190	3200	3180				
75	3190	3200	3180				
76	3190	3200	3180				
77	3190	3200	3180				
78	3190	3200	3180				
79	3190	3200	3180				
80	3190	3200	3180				
81	3190	3200	3180				
82	3190	3200	3180				
83	3190	3200	3180				
84	3190	3200	3180				
85	3190	3200	3180				
86	3190	3200	3180				
87	3190	3200	3180				
88	3190	3200	3180				
89	3190	3200	3180				
90	3190	3200	3180				
91	3190	3200	3180				
92	3190	3200	3180				
93	3190	3200	3180				
94	3190	3200	3180				
95	3190	3200	3180				
96	3190	3200	3180				
97	3190	3200	3180				
98	3190	3200	3180				
99	3190	3200	3180				
100	3190	3200	3180				

CHECKING SPEEDWOOD AND C[illegible], 3000 PSIG RELIEF VALVE
SIZE MS46-4, SERIAL NUMBER 4280

IV. TEMPERATURE TEST RESULTS

Test Condition	Cracking Pressure (psig)	Reseating Pressure (psig)	Test Condition	Cracking Pressure (psig)	Reseating Pressure (psig)
[illegible] Operation [illegible]°F. (The [illegible] was heated to 160°F in a temperature chamber and then removed and tested immediately.)	3100 3190 3190 3190 3190 3190 3190 3190 3190 3190	3150 3150 3150 3150 3150 3150 3170 3170 3170 3170	IV. c. Operation at 21°F. (The valve was cooled to 21°F in a temperature chamber and then removed and tested immediately.)	Leaked above 1500 psig at 21°F (valve temperature) Leaked above 2000 psig at 46°F. Leaked slightly above 2900 psig at 50°F. Valve functioned normally at 54°F. 3190 3150 3160 3160 3150 3160	
IV. b. Room temperature operation [illegible]. (Valve [illegible] at room temperature after exposure at 160°F.)	3180 3190 3190 3190 3190 3190 3190 3190 3190 3190	3170 3180 3180 3175 3170 3175 3175 3175 3175 3175	IV. d. Room temperature operation (70°F). (Valve stabilized at room temperature after exposure at 0°F.)	3180 3190 3190 3180 3190 3190 3190 3190 3190 3190	3170 3180 3180 3175 3175 3175 3175 3175 3175 3175

ARESCON GREENWOOD AND CO. 3200 PSIG RELIEF VALVE
TYPE 31[illegible]-4, SERIAL NUMBER 4150

V. VIBRATION TEST RESULTS

Procedure: The valve was subjected to the following vibration frequencies while pressurized to 3000 psig.

5 to 28 cps at 0.4 inches double amplitude
28 to 2000 cps at 10g

Vibration was applied seperately (1) along (parallel to) the axis (of revolution) of the poppet and spring and (2) perpendicular to the axis of the poppet.

Leakage during vibration was detected by means of a 1/4 inch rubber hose, one end of which was connected to the valve outlet port and the other end immersed in water.

a. Vibration applied parallel to axis of poppet and spring.[1]

Vibration Frequency (cps)	Leakage
5 - 425	0
425 - 460	Very rapid leakage (4 to 10 bubbles/sec.)
460 - 525	~~Excessive leakage (violent bubbling)~~
525 - 2000	0

b. Vibration applied perpendicular to axis of poppet and spring.[2]

Vibration Frequency (cps)	Leakage
5 - 23	0
23 - 75	Slight leakage (less than 1 bubble/sec.)
75 - 110	Rapid leakage (2 to 4 bubbles/sec.)
110	0
110-450	Very rapid leakage (4 to 10 bubbles/sec.)
450 - 460	0
450 - 500	Very rapid leakage
500 - 550	0
550 - 555	Slight leakage
555 - 2000	0

[1] See Figure 6

[2] See Figure 7

LOCKHEED AIRCRAFT CORPORATION
MISSILE SYSTEMS DIVISION

REPORT LMSD/909010

ANDERSON GREENWOOD AND COMPANY, 3200 PSIG RELIEF VALVE,
TYPE 3SB46-4, SERIAL NO. 4180

VI. CYCLE TEST RESULTS

CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)
3160	2475	3180	3170	3180	3170	3180	3170
3190	3180	3180	3170	3180	3170	3180	3170
3190	3180	3180	3170	3180	3170	3180	3170
3190	3180	3180	3170	3180	3170	3180	3170
3200	3180	3180	3170	3180	3170	3190	3180
3200	3190	3180	3170	3180	3170	3190	3180
3200	3180	3180	3170	3180	3170	3190	3180
3200	3180	3180	3170	3180	3170	3190	3180
3200	3180	3180	3170	3180	3170	3190	3180
3190	3150	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3199	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3190	3175	3180	3170	3180	3170	3190	3180
3180	3170	3180	3170	3180	3170	3190	3180
3180	3170	3180	3170	3180	3170	3190	3180
3180	3170	3180	3170	3180	3170	3190	3180
3180	3170	3180	3170	3180	3170	3190	3180
3150	3170	3180	3170	3180	3170	3190	3180
3160	3170	3180	3170	3180	3170	3190	3180
3180	3170	3180	3170	3180	3170	3190	3180
3160	3170	3180	3170	3180	3170	3190	3180
3180	3170	3180	3170	3180	3170	3190	3180
3160	3170	3180	3170	3180	3170	3190	3180
3160	3170	3180	3170	3180	3170	3190	3180
3160	3170	3180	3170	3180	3170	3190	3180

FORM [illegible]

ANDERSON GREENWOOD AND COMPANY, 3200 PSIG RELIEF VALVE,
TYPE 3JS46-4, SERIAL NO. 4180

VI. CYCLE TEST RESULTS

CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)
3190	3180	3190	3180	3200	3190	3200	3190
3190	3180	3190	3180	3200	3190	3200	3190
3190	3180	3190	3180	3200	3190	3200	3190
3190	3180	3190	3180	3200	3190	3200	3190
3190	3180	3190	3180	3200	3190	3200	3190
3190	3180	3190	3180	3200	3190	3200	3190
3190	3180	3190	3180	3200	3190	3200	3190
3190	3180	3190	3180	3200	3190	3200	3190
3190	3180	3190	3180	3200	3190	3200	3190
3190	3180	3190	3180	3200	3190	3200	3190
3190	3180	3190	3180	3200	3190	3200	3190
3190	3180	3190	3180	3200	3190	3200	3190
3190	3180	3190	3180	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190
3190	3180	3200	3190	3200	3190	3200	3190

LOCKHEED AIRCRAFT CORPORATION
MISSILE SYSTEMS DIVISION
REPORT LMSD/909010

ANDERSON GREENWOOD AND COMPANY, 3200 PSIG RELIEF VALVE,
TYPE 3JS46-4, SERIAL NO. 4160

VI. CYCLE TEST RESULTS

CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)
3190	3160	3190	3170				
3220	3170	3190	3160				
3190	3160	3190	3160				
3190	3180	3190	3180				
3190	3160	3190	3160				
3190	3160	3190	3180				
3190	3180	3190	3180				
3190	3160	3200	3180				
3190	3180	3200	3190				
3190	3180	3200	3190				
3190	3160	3200	3190				
3190	3180	3200	3190				
3190	3180	3200	3190				
3190	3180	3200	3190				
3190	3180	3200	3190				
3190	3180	3200	3190				
3190	3180	3200	3190				
3190	3180	3200	3190				
3190	3180	3200	3190				
3190	3180	3200	3190				
3190	3180	3200	3190				
3190	3180	3200	3190				
3190	3180	3200	3190				
3190	3180	3200	3190				
3190	3180	3200	3190				
3190	3180	3200	3190				
3190	3180	3210	3190				
3190	3180	3210	3190				
3190	3180	3210	3190				
3190	3180	3210	3190				
3190	3180	3210	3190				
3190	3180	3210	3190				
3190	3180	3210	3190				
3190	3180	3210	3190				
3190	3180	3210	3190				
3190	3180	3210	3190				
3190	3180	3210	3190				
3190	3180	3210	3190				
3190	3180	3210	3190				
3190	3180	3210	3200				
3190	3180	3210	3200				
3190	3180	3210	3200				
3190	3180	3210	3200				
3190	3180	3210	3200				
3190	3180	3210	3200				
3190	3180	3210	3200				
3190	3180	3210	3200				

FORM NO. 9367

Anderson Greenwood and Co., 3200 PSIG Relief Valve, Type 33346-4

Serial Number 4160

VII TEMPERATURE TEST RESULTS

TEST CONDITION	CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)
VII.a. Operation at 160°F. (The valve was heated to 160°F in a temperature chamber and then removed and tested immediately.)	3190 3190 3180 3170 3180* 3190* 3180* 3160 3160 3160* 3160* 3160	3170 3160 3170 3150 3170 3170 3170 3140 3140 3140 3140 3150
VII.B. Room temperature operation (70°F). (Valve stabilized at room temperature after exposure at 160°F).	3190 3190 3190 3190 3180 3180 3190 3190 3190 3190	3180 3180 3180 3170 3170 3170 3180 3180 3170 3170
VII.c. The valve was cooled in a temperature chamber while pressurized to 2700 PSIG with helium and began to leak when the valve body temperature dropped to 40°F.		

The valve was then disassembled and inspected. All internal parts, including the poppet O-ring and valve seat, were in good condition. (See Figure 8)

A new poppet O-ring (designated compound No. 435-90) was installed and the valve was reassembled and subjected to an additional temperature test.

Anderson Greenwood and Co., 3200 PSIG Relief Valve, Type 3JS46-4

Serial Number 4180

VIII TEMPERATURE TEST RESULTS[1]

TEST CONDITION	CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)	TEST CONDITION	CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)
VIII.a. Room temperature operation (60°F)	3230 3230 3230 3230 3230 3220 3230 3230 3220 3210	3210 3210 3210 3210 3210 3200 3210 3210 3200 3200	VIII.b. Operation at 0°F. (Same as VIII.b.	The valve leaked at temperatures below 42°F.	
			The valve was disassembled and inspected. The seat assembly had loosened slightly and the nozzle O-ring seal was partially extruded.[2] A new poppet O-ring (compound 435-90) and nozzle O-ring (Viton-A) were installed and the valve was reassembled.		
VIII.c. Operation at 0°F. (The valve was cooled to 0°F in a temperature chamber and then removed and tested immediately.)	3190 3190 3180 3190 3180 3190 3190 3190 3200 3250 3250	3150 3120 3100 3100 3090 3110 3120 3180 3180 3200	VIII.f. Room temperature operation (70°F)	3210 3210 3270 3300* 3300* 3250 3250 3240	3150 3140 3140 --- --- 3160 3160 3170
VIII.e. Room temperature operation (70°F). (Valve stabilized at room temperature after exposure at 160°F.)	3260 3260 3250 3250 3260 3260 3260 3260 3260	3240 3240 3240 3240 3240 3230 3230 3230 3230 3240	VIII.g. Operation at 0°F. (Same as VIII.b.)	Valve leaked excessively at 0°F and 15°F.	
VIII.d. Operation at 160°F. (The valve was heated to 160°F in a temperature chamber and then removed and tested immediately.	3240 3240 3250 3250 3250 3250 3240 3240 3240 3250	3230 3230 3230 3210 3210 3210 3210 3210 3210 3200	Testing was discontinued and the valve was returned to the manufacturer.		

[1] A compound No. 435-90 poppet O-ring was used during this test.

[2] See Figures 9 and 10

ANDERSON GREENWOOD AND CO., 6500 PSIG RELIEF VALVE, TYPE 3JS46-3

SERIAL NUMBER 4179

I. INSPECTION RESULTS

Visual inspection of this valve revealed no evidence of external damage, defects, or contaminants.

II. TEMPERATURE TEST RESULTS

TEST CONDITION	CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)
II.a. Room temperature operation (70°F).	6500 6500 6460 6500 6480 6500 6500 6500 6500 6500	6300 6250 6240 6300 6300 6300 6280 6310 6300 6300
II.b. Operation at 160°F. (The valve was heated to 160°F in a temperature chamber and then removed and tested immediately.)	6440 6400 6400 6390 6390 6390 6380 6380 6380 6390	6300 6280 6290 6200 6200 6200 6200 6200 6200 6200
II.c. Operation at 0°F. (The valve was cooled to 0°F in a temperature chamber and then removed and tested immediately.)	The valve leaked at pressures in excess of 4800 PSIG.	
The valve was disassembled and inspected. A damaged nozzle O-ring seal was discovered which apparently had been pinched during assembly. A buna-N O-ring was installed on the nozzle and a Viton-A (90 durometer) O-ring was installed on the poppet. The valve was reassembled and retested.[1]		

TEST CONDITION	CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)
II.d. Room temperature operation (70°F).	6380 6360 6360 6400 6360	6150 6180 6180 6160 6180
The valve started leaking at pressures in excess of 4500 PSIG when an attempt was made to reset the cracking pressure to 6500 PSIG. Disassembly and inspection of the valve revealed that the poppet O-ring had failed (compression fracture).[2]		
A complete set of Viton-A O-rings were then installed in the valve and it was reassembled, reset and retested.		
II.e. Room temperature operation (70°F).	6550 6580 6660* 6660* 6580 6540 6600 6690* 6650* 6540	6340 6340 6320 6320 6320 6350 6320 6320 6300 6310
II.f. Operation at 0°F. (Same as II.c.)	The valve leaked at temperatures below 34°F.	
The valve was disassembled and a new poppet O-ring (compound No. 435-90) was installed. The valve was then reassembled, reset and retested. The blowdown ring was, also, adjusted to raise the reseating pressure		

[1] See Figures 11 and 12

[2] See Figure 13

ANDERSON GREENWOOD AND CO., 6500 PSIG RELIEF VALVE, TYPE 3JS46-3

SERIAL NUMBER 4179

II. TEMPERATURE TEST RESULTS (CONTINUED)

TEST CONDITION	CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)
II.g. Room temperature operation (80°F).	6550 6550 6500 6490 6500 6500 6490 6490 6490 6490 6550	6480 6410 6410 6410 6420 6410 6400 6400 6400 6400 6410
II.h. Operation at 18°F. (Valve was cooled to 18°F in a temperature chamber and then removed and tested immediately.)	Valve leaked at temperatures below 40°F.	
II.i. Room temperature operation (70°F). (Valve stabilized at room temperature after exposure at 18°F.)	6590 6580 6560 6550 6550 6550 6530 6600* 6600* 6520	6510 6510 6500 6500 6500 6470 6470 6410 6410 6400
II.j. Operation at 160°F. (Valve was heated to 160°F in a temperature chamber and then removed and tested immediately.	6480 6480 6550* 6550* 6480 6470 6420 6490 6490 6550	6410 6400 6350 6350 6410 6310 6380 6370 6400 6350
The valve was disassembled and inspected. The nozzle assembly was loose and the nozzle O-ring was partially extruded from its groove. A new poppet O-ring (compound No. 435-90) and a new nozzle O-ring (Viton-A) were installed and the valve was reassembled and retested.		
II. k. Room temperature operation (75°F).	6600 6590 6590 6500* 6510 6500* 6500* 6500 6490 6480	6500 6450 6450 6480 6480 6460 6480 6450 6400 6400
II.i. Operation at 0°F. (Valve was cooled to 0°F in a temperature chamber and then removed and tested immediately.)	6650 6590 6590 6500* 6510	6490 6420 6400 6390 6400
II.m. Room temperature operation (75°F).	6490 6480 6480 6500 6480	6410 6400 6400 6300 6400
II.n. Operation at 160°F.	6390 6350 6360 6350 6400*	6300 6320 6330 6330 6350
II.o. Operation at 0°F.	Valve leaked at temperatures below 45°F.	
Testing discontinued, valve returned to manufacturer.		

FLUID MECHANICS, 3500 PSIG RELIEF VALVE

PART NO. 44-3G-8-SP, SERIAL NO. 498

I. INSPECTION RESULTS

Visual inspection of this valve revealed no evidence of damage, defects, or contaminants.

II. TEMPERATURE TEST RESULTS

TEST CONDITION	CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)
I.a. Room temperature operation (75°)	3520 3510 3500 3490 3490 3480 3480 3480 3550* 3550*	3390 3350 3325 3325 3340 3330 3340 3330 — —
I.b. Operation at 0°F	3490 3550* 3550* 3490 3500 3490 3490 3490 3490 3480	3320 — — 3330 3340 3330 3330 3330 3300 3340
I.c. Operation at 160°F	3450 3390 3390 3370 3360 3370 3450* 3450* 3400 3420	3300 3220 3230 3230 3220 3240 3300 3300 3270 3300

[illegible] AIRCRAFT CORPORATION

Page [illegible]

[illegible]

FLUID MECHANICS, [illegible] RELIEF VALVE
PART NO. 14-TR-8-3P, SERIAL NO. 498

III. CYCLE TEST RESULTS

[illegible]	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)
3420	3340	3430	3320	3420	3330	3420	3340
3420	3330	3430	3320	3420	3330	3450	3350
3420	3340	3430	3320	3420	3330	3440	3350
3420	3340	3430	3320	3420	3330	3440	3340
3420	3330	3430	3320	3420	3330	3440	3350
3420	3330	3430	3320	3420	3330	3440	3350
3420	3330	3430	3320	3420	3330	3440	3350
3420	3330	3430	3320	3420	3330	3430	3350
3420	3330	3430	3330	3420	3330	3430	3350
3420	3320	3430	3330	3420	3340	3420	3340
3420	3320	3430	3330	3420	3340	3420	3340
3420	3320	3440	3330	3420	3340	3480	3340
3420	3320	3440	3330	3430	3340	3420	3340
3430	3320	3440	3330	3430	3340	3420	3340
3420	3320	3440	3330	3430	3340	3420	3340
3420	3320	3440	3330	3430	3340	3420	3340
3420	3320	3440	3330	3430	3340	3420	3340
3420	3320	3440	3330	3430	3340	3420	3340
3420	3320	3440	3330	3430	3340	3420	3340
3420	3320	3440	3330	3430	3340	3420	3340
3420	3320	3440	3330	3430	3340	3420	3340
3420	3320	3420	3340	3430	3340	3450	3350
3420	3320	3420	3330	3420	3340	3440	3340
3420	3320	3420	3330	3420	3340	3420	3340
3420	3320	3420	3330	3420	3340	3420	3340
3430	3310	3420	3330	3420	3330	3420	3320
3430	3310	3420	3330	3420	3330	3420	3330
3430	3310	3420	3330	3420	3330	3420	3330
3430	3310	3430	3340	3420	3340	3420	3330
3430	3310	3430	3340	3420	3340	3420	3330
3430	3310	3430	3340	3420	3340	3420	3330
3430	3310	3420	3330	3420	3340	3420	3330
3430	3310	3420	3330	3420	3340	3420	3330
3430	3310	3420	3330	3420	3340	3420	3330
3430	3310	3420	3330	3420	3340	3420	3330
3430	3310	3420	3330	3420	3350	3420	3330
3420	3310	3420	3330	3420	3350	3420	3330
3430	3310	3420	3330	3420	3340	3420	3330
3430	3310	3420	3330	3420	3340	3420	3330
3430	3310	3420	3330	3420	3340	3420	3330
3430	3310	3420	3330	3430	3350	3420	3330
3430	3310	3420	3330	3420	3350	3420	3330
3420	3310	3420	3330	3420	3340	3420	3320
3420	3310	3420	3330	3420	3350	3420	3320
3420	3310	3420	3330	3420	3340	3420	3320
3430	3310	3420	3330	3420	3340	3420	3330
3450	3330	3420	3330	3420	3340	3420	3330
3420	3320	3420	3330	3420	3340	3420	3330
3420	3320	3420	3330	3420	3340	3420	3330
3420	3320	3420	3330	3420	3340	3420	3330

FLUID MECHANICS, 3500 PSIG RELIEF VALVE
PART NO. 44-TC-8-SP, SERIAL NO. 408

III. CYCLE TEST RESULTS

CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)
3420	3330	3420	3330	3440	3350	3420	3350
3420	3330	3420	3330	3430	3350	3420	3350
3420	3330	3420	3340	3420	3340	3420	3350
3420	3330	3420	3340	3420	3340	3410	3350
3420	3330	3420	3330	3420	3340	3440	3350
3420	3330	3420	3330	3420	3340	3440	3350
3420	3330	3425	3330	3420	3340	3440	3350
3420	3340	3425	3330	3420	3340	3420	3350
3420	3340	3430	3330	3420	3350	3440	3350
3420	3340	3420	3340	3420	3350	3420	3350
3420	3340	3420	3340	3440	3350	3420	3350
3420	3340	3420	3330	3430	3350	3420	3350
3420	3340	3420	3340	3430	3340	3450	3380
3420	3340	3420	3340	3420	3350	3440	3360
3420	3340	3440	3340	3420	3350	3420	3360
3420	3340	3420	3340	3420	3350	3420	3360
3420	3340	3420	3340	3420	3350	3420	3360
3450	3330	3450	3340	3420	3350	3420	3350
3450	3340	3430	3340	3420	3350	3420	3350
3450	3340	3450	3340	3420	3350	3420	3350
3450	3340	3430	3340	3420	3350	3420	3360
3450	3340	3430	3340	3420	3350	3420	3360
3450	3340	3430	3340	3420	3350	3420	3360
3450	3340	3420	3340	3420	3350	3420	3360
3440	3340	3420	3340	3420	3350	3420	3350
3440	3340	3420	3340	3420	3340	3420	3350
3430	3340	3420	3340	3410	3350	3420	3350
3430	3340	3420	3340	3410	3350	3420	[illegible]
3430	3340	3420	3340	3430	3350	3420	3360
3430	3330	3420	3340	3430	3350	3420	3360
3430	3330	3420	3340	3430	3350	3420	3360
3420	3330	3420	3340	3430	3350	3420	3360
3420	3330	3420	3340	3430	3350	3420	3360
3420	3340	3420	3340	3420	3350	3410	3360
3420	3340	3420	3340	3420	3350	3410	3360
3420	3330	3420	3340	3420	3350	3410	3360
3420	3330	3420	3340	3430	3350	3420	3350
3420	3330	3420	3330	3420	3350	3420	3350
3420	3330	3420	3340	3430	3350	3420	3350
3420	3330	3420	3340	3450	3350	3420	3350
3420	3330	3420	3340	3430	3350	3420	3360
3420	3330	3420	3340	3430	3350	3420	3360
3420	3330	3430	3340	3430	3350	3420	3360
3420	3330	3430	3340	3420	3340	3410	3360
3420	3330	3430	3340	3420	3350	3410	[illegible]
3420	3330	3430	3340	3420	3350	3410	3360
3420	3330	3420	3340	3420	3350	3430	3350
3420	3330	3420	3340	3420	3350	3430	3350
3420	3330	3420	3340	3420	3350	3420	3360

WELD NOZZLES, 3000 PSIG RELIEF VALVE
PART NO. 44-70-8-97, SERIAL NO. 490

[illegible] CYCLE	[illegible] RESEATING PRESSURE (psig)	[illegible] CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)
[illegible]	3360	3340	3290				
[illegible]	3360	3360	3290				
[illegible]	3360	3360	3290				
[illegible]	3360	3360	3290				
[illegible]	3360	3360	3290				
[illegible]	3360	3360	3290				
[illegible]	3360	3350	3290				
[illegible]	3360	3350	3290				
[illegible]	3360	3350	3290				
[illegible]	3360	3350	3290				
[illegible]	3360	3350	3290				
[illegible]	3360	3350	3290				
[illegible]	3350	3350	3290				
[illegible]	3350	3350	3290				
[illegible]	3350	3350	3290				
[illegible]	3350	3350	3290				
[illegible]	3360	3350	3290				
[illegible]	3360	3340	3300				
[illegible]	3360	3350	3300				
[illegible]	3360	3350	3300				
[illegible]	3360	3350	3300				
[illegible]	3360	3350	3300				
3390	3325	3360	3300				
3380	3340	3360	3290				
3370	3315	3350	3290				
3360	3300	3350	3290				
3360	3300	3350	3290				
3350	3290	3350	3290				
3350	3290	3350	3290				
3350	3290	3350	3290				
3350	3290	3350	3300				
3350	3290	3350	3300				
3370	3300	3350	3300				
3360	3290	3350	3300				
3360	3290	3350	3300				
3360	3290	3350	3300				
3360	3290	3350	3300				
3350	3290	3350	3300				
[illegible]	3290	3350	3300				
[illegible]	3290	3350	3300				
[illegible]	3290	3350	3300				
[illegible]	3290	3350	3300				
[illegible]	3290	3350	3300				
[illegible]	3290	3350	3300				
3350	3290	3350	3300				
3350	3290	3360	3290				
3350	3290	3360	3290				
3350	3290	3360	3300				
[illegible]	3290	3360	3300				
[illegible]	3290	3360	3300				
[illegible]	3290	3350	3300				

[illegible], 3500 PSIG RELIEF VALVE,

[illegible], SERIAL NO. 198

[illegible]

TEST CONDITION	CRACKING PRESSURE (PSIG)	RESEAT PRESSURE (PSIG)
IV.a. Operation at [illegible]	3250	3240
	3240	3150
	3260	3260
	3300	–
	3300	–
	3340	3250
	3330	3140
	3340	3140
	3230	3130
	3300	3200
IV.b. Operation at room temperature (70°F)	3300	3060
	3350	2950
	3350	2900
	3350	3060
IV.c. Operation at 0°F	3400	3250
	3340	3125
	3340	3120
	3340	3130
	3350	3050
	3350	3060

[illegible] HIGH PRESSURE, 3500 PSIG RELIEF VALVE,

PART NO. M-10-8-SP, SERIAL NO. 498

IV TEMPERATURE TEST RESULTS

TEST CONDITION	CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)
IV.a. Operation at 160°F	3280	3140
	3240	3150
	3240	3150
	3300	—
	3300	—
	3240	3150
	3230	3140
	3240	3140
	3230	3130
	3300	3200
IV.b. Operation at room temperature (70°F)	3300	3050
	3250	2950
	3250	2980
	3250	3000
IV.c. Operation at 0°F	3400	3100
	3340	3125
	3340	3120
	3340	3120
	3350	3050
	3350	3050

FLUID MECHANICS, 6500 PSIG RELIEF VALVE

PART NO. 44-T3-8-3P, SERIAL NO. 497

I. INSPECTION RESULTS

Visual inspection of this valve revealed no evidence of damage, defects, or contaminants.

II. TEMPERATURE TEST RESULTS

TEST CONDITION	CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)
II.a. Operation at room temperature (70°F)	6525 6500 6460 6500 6480 6450 6450 6450 6450 6450	6400 6325 6390 6340 6350 6350 6350 6360 6350 6350
II.b. Operation at 140°F.	6300 6210 6180 6180 6180 6180 6190 6180 6160 6190	6080 6080 6050 6050 6040 6050 6060 6040 6050 6040
II.c. Operation at room temperature (70°F)	6310 6300 6320 6320 6320 6320 6320 6320 6320 6320	6050 6080 6090 6060 6050 6050 6100 6110 6100 6120

TEST CONDITION	CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)
II.d. Operation at 0°F.	Valve leaked excessively at 3000 PSIG.	
Valve was reset to crack at 6600 PSIG.		
II.e. Operation at room temperature (75°F)	6610 6600 6580 6570 6570 6590 6670 6610 6600 6580	6530 6530 6520 6530 6550 6600 6590 6550 6510 6500
II.f. Operation at 0°F.	6030 6000 6100	5950 5950 5950
II.g. Operation at 47°F.	6660 6610 6600 6600	6530 6490 6500 6500
A new inner valve assembly (consisting of the poppet, seat, and seal) was installed in this valve. The seal material was Kel-F.		

FLUID MECHANICS, 6500 PSIG RELIEF VALVE

PART NO. 44-TG-8-SP, SERIAL NO. 497

II. TEMPERATURE TEST RESULTS (CONTINUED)

TEST CONDITION	CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)
II.h. Operation at room temperature (70°F)	6480 6480 6470 6460 6460 6450 6440 6500* 6190 6150	6400 6450 6410 6420 6410 6400 6200 5750 5850 5900
II.i. Operation at 4°F. (Valve temperature was maintained constant at 4°F).	6290 6220 6210 6210 6220 6220 6210 6210 6350* 6120	6000 6000 6010 6010 6000 6000 6050 5000 5900 5900
II.j. Operation at room temperature (70°F).	6220 6180 6150 6400* 6190	5900 5900 5890 5820 5860
II.k. Operation at 160°F.	6000 6000 5980 5960 5960 6150* 5950 5900 5900 5880	5650 5600 5600 5600 5550 — 5000 5450 5450 5430
A new inner valve assembly was again installed in this valve. The seal material was Nylon.		

TEST CONDITION	CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)
II.l. Operation at room temperature (70°F).	6460 6450 6450 6500* 6450 6450 6500* 6500* 6430 6420	6410 6400 6400 — 6400 6400 6400 — 6400 6400
II.m. Operation at 160°F.	6180 6180 6180 6300* 6180 6120 6110 6110 6300* 6100	6150 6150 6150 — 6100 6090 6090 6090 — 6090
II.n. Operation at room temperature (70°F).	6200 6200 6200 6300* 6300* 6120 6110	6150 6120 6130 6150 — 6050 6050
II.o. Operation at 0°F.	Valve cracking pressure ranged from 6140 to 6190 PSIG and reseating pressures ranged from 5750 to 6050. However, the valve leaked very slightly (2 bubbles/min.) at pressures above 5600 PSIG.	

FLUID MECHANICS, 6500 PSIG RELIEF VALVE

PART NO. 44-TG-8-SP, SERIAL NO. 497

III. CYCLE TEST - 50 CYCLES

CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)	CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)
6180	6090	6190	6090
6180	6090	6190	6090
6200	6100	6190	6090
6190	6100	6190	6090
6180	6090	6180	6090
6180	6090	6180	6090
6180	6090	6180	6090
6180	6100	6190	6090
6180	6090	6170	6090
6190	6100	6190	6090
6180	6090	6180	6090
6180	6090	6180	6090
6190	6090	6190	6090
6180	6090	6180	6090
6190	6090	6190	6090
6180	6090	6190	6090
6190	6090	6180	6090
6180	6090	6180	6090
6180*	6090	6190	6090
6250*	—	6190	6090
6190	6090	6180	6090
6180	6090	6180	6090
6180	6090	6180	6090
6180	6090	6190	6090
6190	6090	6180	6090

FLUID MECHANICS, 6500 PSIG RELIEF VALVE

PART NO. 44-TG-8-SP, SERIAL NO. 497

IV TEMPERATURE TEST RESULTS

TEST CONDITION	CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)
Valve was reset to crack at 6500 PSIG.		
IV.a. Operation at room temperature (70°F)	6525 6490 6500 6510 6510	6480 6450 6400 6420 6450
IV.b. Operation at 0°F.	6500 6490 6690* 6800* 6800* 6480	6150 6300 6250 6100 6180 6200
Valve leaked slightly above 3000 PSIG. Leakage at 5000 PSIG after reseat was greater.		
IV.c. Operation at 160°F.	6380 6380 6380 6370 6360 6400* 6320 6310 6310 6300	6350 6330 6310 6310 6310 -- 6280 6260 6260 6260

LOCKHEED AIRCRAFT CORPORATION
MISSILE SYSTEMS DIVISION

REPORT LMSD/909010

FLUID MECHANICS, 6500 PSIG RELIEF VALVE
PART NO. 44-TG-8-SP, SERIAL NO. 497

1 CYCLE TEST RESULTS

CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)
6380	6220	6400	6220				
6360	6200	6400	6220				
6360	6200	6400	6220				
6370	6200	6400	6220				
6450	6220	6410	6220				
6450	6220	6410	6220				
6350	6210	6410	6220				
6360	6200	6410	6220				
6380	6220	6410	6220				
6380	6220	6410	6220				
6380	6220						
6380	6220						
6380	6200						
6400	6220						
6380	6220						
6380	6220						
6410	6250						
6410	6240						
6400	6210						
6400	6210						
6380	6220						
6400	6220						
6380	6220						
6410	6220						
6380	6220						
6410	6220						
6400	6220						
6400	6220						
6420	6250						
6410	6250						
6410	6220						
6410	6220						
6410	6220						
6410	6220						
6400	6220						
6400	6220						
6410	6220						
6410	6220						
6410	6220						
6400	6220						

W. H. LADEWIG CO., 3200 PSIG RELIEF VALVE

PART NO. 154S, SERIAL NO. B59, C59 and 059

I. INSPECTION RESULTS

Visual inspection of this valve revealed no evidence of damage, defects, or contaminants.

II. TEMPERATURE TEST RESULTS

TEST CONDITION	CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)
I.a. Room temperature operation (70°F)	3120 3120 3150 3150 3150 3140 3150 3150 3150 3150	— 3050 3090 3080 3060 3080 3100 3100 3100 3100
I.b. Operation at 200°F. (Valve was heated to 200°F in a temperature chamber and then removed and tested immediately).	2720 2720 2720 2710 2720 2710 2700 2740 2710 2710	2500 2500 2490 2490 2500 2500 2490 2500 2500 2500
I.c. Room temperature operation (70°F)	Valve leaked at pressures in excess of 550 PSIG.	
This valve (Serial no B59 was returned to the manufacturer for repair.		
A new valve (Serial No C59) was received and it cracked at approximately 3100 PSIG but did not reseat bubble tight until the pressure dropped to approximately 2000 PSIG. This valve was, also, returned to the manufacturer.		

TEST CONDITION	CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)
Another valve (Serial No. 059) was received and tested as indicated below.		
I.d. Room temperature operation (70°F)	3320 3160 3050 3010 3100 3010 3010 3010 2980 2980	— — 2880 2940 — 2890 2980 2830 2910 2910
I.e. Operation at 0°F.	This valve leaked at pressures in excess of 2300 PSIG.	
I.f. Room temperature operation (70°F).	3090 3030 3030	2910 2910 2910
I.g. Operation at 160°F.	2980 2980 3000 3030 3030 3040 3020 3040 3010 3010	2900 — 2950 2940 2940 2940 2910 2910 2850 2850
I.h. Room temperature operation (70°F)	Valve leaked at all pressures in excess of 50 PSIG.	
Testing was discontinued and valve was returned to manufacturer.		

VACCO VALVE CO., 3200 PSIG RELIEF VALVE

PART NO. RV90-4P-403

I. INSPECTION RESULTS

Visual inspection of this valve revealed no evidence of damage, defects or contaminants.

II. TEMPERATURE TEST RESULTS

TEST CONDITION	CRACKING PRESSURE (PSIG)	FULL OPEN PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)
II.a. Operation at room temperature (70°F).	3030	--	2870
	3035	--	2820
	3000	3375	2480
	2800	3100	2510
	2950	3000	2300
	2500	2600	2350
	2350	2580	2030
	2350	2600	2050
	2500	2550	1950
	2300	2550	2100

Testing was discontinued and the valve was returned to the manufacturer. No further testing was scheduled for this valve because of the large amount of unsatisfactory data obtained during previous acceptance tests (100% rejection).

The primary problem with this valve was the large change in cracking pressure which was caused by the extrusion of the nylon seat of the pilot valve. Also, the valves were heavily rusted internally, which was apparently caused by the use of distilled water for proof testing and inadequate removal of the trapped water.

VISSOT MANUFACTURING CO., 3200 PSIG RELIEF VALVE

PART NO. A-[illegible]0, SERIAL NO. 1003

I. INSPECTION RESULTS

Visual inspection of this valve revealed no evidence of damage, defects, or contaminants.

II. TEMPERATURE TEST RESULTS

TEST CONDITION	CRACKING PRESSURE (PSID)	RESEATING PRESSURE (PSID)
II. a. Operation at room temperature (80°F)	3310	--
	3300	3230
	3300	3200
	3310	3200
	3300	3200
	3320	3240
	3320	3180
	3310	3160
	3330	3140
	3310	3120
II.b. Operation at 160°F	3250	3200
	3250	3210
	3260	3200
	3260	3170
	3260	3140
II.c. Operation at room temperature (70°)	Cracking pressure was approximately 2900 PSID but the valve leaked down to 2000 PSID after cracking.	
The valve was disassembled and the conical poppet was replaced by a hemispherical (seating surface) poppet. (The seal material (Kel-F) was extruded slightly and the conical poppet was touching metal to metal.)		

TEST CONDITION	CRACKING PRESSURE (PSID)	RESEATING PRESSURE (PSID)
II.d. Operation at room temperature (70°F)	3210	3070
	3220	3070
	3220	3030
	3210	3000
	3210	3000
	3210	3000
	3230	3000
	3210	3010
	3200	3000
	3200	3000
II.e. Operation at 160°F	3140	3000
	3150	3010
	3140	3010
	3140	3010
	3140	3020
	3140	3020
	3140	3020
	3140	3020
	3140	3020
	3140	3020
II.f. Operation at room temperature (70°F).	3150	2950
	3140	2950
	3150	2950
	3140	2910
	3140	2910
	3140	2900
	3140	2900
	3140	2900
	3140	2900
	3140	2900

VINSON MANUFACTURING CO., 3200 PSIG RELIEF VALVE

PART NO. A-80040, SERIAL NO. 1003

II. TEMPERATURE TEST RESULTS (CONTINUED)

TEST CONDITION	CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)
II.g. Operation at 0°F.	3140	2880
	3140	2890
	3140	2860
	3140	—
	3140	—
	3140	—
	3140	2890
	3150	—
	3150	—
	3140	2890
The valve was returned to the vendor for modification and rework of the seat seal (Kel-F)		
II.h. Operation at room temperature (70°F)	3230	2980
	3250	3220
	3250	3250
	3250	3220
	3250	3170
	3250	3160
	3250	3100
	3250	3150
	3250	3190
	3250	3150
II.i. Operation at 160°F.	3240	3170
	3240	3150
	3240	3060
	3210	3030
	3210	3020
	3210	3050
	3220	3010
	3200	3010
	3210	3010
	3200	3020

TEST CONDITION	CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)
II.j. Operation at room temperature (70°F).	3290	3250
	3290	3260
	3300	3270
	3300	3260
	3300	3270
	3300	3260
	3300	3250
	3300	3260
	3300	3260
	3300	3260
II.k. Operation at 0°F.	3150	3100
	3240	3200
	3250	3100
	3240	3110
	3240	3110
	3240	3100
	3230	3100
	3230	3100
	3240	3070
	3250	3100

[illegible] AIRCRAFT CORPORATION

[illegible] MANUFACTURING CO., [illegible] VALVE,
PART NO. A-80040, SERIAL NO. [illegible]

XII. CYCLE TEST RESULTS

CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)
3290	3240	3290	3100	3290	3100	3300	3150
3290	3240	3290	3100	3290	3090	3300	3100
3290	3240	3290	3080	3320	3100	3290	3100
3290	3240	3290	3080	3310	3100	3290	3080
3290	3240	3290	3100	3310	3100	3290	3090
3290	3240	3290	3100	3300	3100	3290	3100
3290	3240	3290	3090	3300	3100	3290	3100
3290	3240	3280	3080	3300	3100	3290	3100
3290	3240	3290	3100	3300	3100	3290	3100
3290	3240	3275	3100	3310	3120	3290	3100
3290	3240	3290	3110	3310	3110	3300	3110
3290	3240	3290	3110	3300	3110	3280	3210
3280	3210	3290	3100	3300	3110	3280	3210
3300	3080	3290	3100	3300	3110	3300	3225
3300	3100	3290	3100	3300	3110	3300	3150
3300	3125	3290	3100	3290	3100	3300	3150
3240	3075	3290	3100	3300	3100	3300	3150
3310	3120	3280	3090	3300	3100	3300	3125
3300	3100	3290	3110	3300	3100	3300	3125
3290	3090	3290	3100	3300	3100	3300	3125
3250	3170	3290	3100	3300	3100	3300	3120
3260	3200	3290	3100	3300	3100	3300	3110
3250	3160	3290	3100	3300	3100	3300	[illegible]
3260	3150	3290	3100	3300	3100	3300	3120
3260	3090	3290	3100	3300	3100	3310	3125
3290	3080	3290	3100	3290	3100	3300	3125
3275	3100	3290	3100	3290	3100	3300	3125
3280	3100	3290	3100	3300	3100	3300	3125
3290	3080	3280	3080	3300	3100	3300	3125
3280	3100	3290	3100	3300	3100	3300	3125
3275	3100	3290	3100	3300	3100	3300	3100
3280	3090	3290	3100	3300	3100	3300	3100
3280	3090	3290	3100	3300	3100	3300	3100
3280	3100	3290	3100	3300	3100	3300	3100
3280	3080	3290	3100	3300	3100	3300	3100
3270	3090	3290	3100	3300	3100	3300	3100
3270	3100	3290	3100	3300	3100	3300	3100
3275	3110	3290	3100	3300	3100	3300	3100
3275	3100	3290	3100	3300	3100	3290	3100
3280	3090	3290	3100	3300	3100	3290	3150
3290	3110	3290	3100	3300	3200	3290	3150
3300	3100	3290	3100	3300	3210	3290	3100
3290	3110	3290	3100	3300	3100	3290	3110
3290	3110	3290	3100	3300	3150	3290	3150
3290	3110	3290	3100	3300	3175	3290	3150
3290	3110	3290	3090	3300	3100	3290	3140
3290	3100	3300	3100	3300	3120	3290	3140
3280	3100	3300	3100	3300	3100	3290	3140
3290	3090	3300	3100	3300	3200	3290	3140
3290	3100	3300	3100	3290	3200	3290	3140

VENSON MANUFACTURING CO., 3200 PSIG RELIEF VALVE,
PART NO. A-60040, SERIAL NO. 1003

III. CYCLE TEST RESULTS

CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)
3290	3100	3300	3100	3300	3290	3300	3110
3290	3100	3300	3100	[illegible]	3110	3300	3120
[illegible]	3100	3300	3100	[illegible]	3110	3300	3110
3290	3100	[illegible]	3100	[illegible]	3110	3300	3110
3290	3100	3300	3120	[illegible]	3110	3300	3110
3300	3120	3300	3120	[illegible]	3110	3300	3110
3300	3120	3300	3120	[illegible]	3110	3300	3110
3260	3210	[illegible]	3120	[illegible]	3110	3310	3125
3260	3200	[illegible]	3120	[illegible]	3110	3300	3125
3280	3180	3300	3120	[illegible]	3110	3300	3120
3280	3175	3300	3150	[illegible]	3110	3300	3090
3290	3260	3300	3200	[illegible]	3110	3290	3090
3300	3280	[illegible]	3250	[illegible]	3110	3290	3100
3290	3270	3300	3225	[illegible]	3110	3290	3100
3290	3280	3300	3200	[illegible]	3110	3290	3100
3290	3250	3300	3200	[illegible]	3110	3290	3100
3290	3240	3300	3150	[illegible]	3110	3290	3080
3290	3240	3325	3160	[illegible]	3110	3300	3100
3290	3240	3310	3125	[illegible]	3110	3310	3100
3290	3240	3300	3125	[illegible]	3110	3310	3100
3290	3230	3290	3110	[illegible]	3110	3310	3100
3300	3125	3290	3100	[illegible]	3115	3310	3100
3300	3125	3290	3100	[illegible]	3115	3300	3100
3300	3125	3290	3100	[illegible]	3115	3300	3100
3300	3125	3290	3100	[illegible]	3115	3300	3100
3300	3125	3290	3100	[illegible]	3115	3300	3100
3290	3100	3290	3100	[illegible]	3115	3300	3100
3290	3090	3300	[illegible]	[illegible]	3115	3310	[illegible]
[illegible]	3100	3300	3100	[illegible]	3110	3310	3115
3290	3100	3300	3100	3300	3100	3310	3110
3290	3120	3290	3125	3300	3110	3310	3140
3310	3120	3290	3125	3300	3110	3310	3140
3300	3110	3290	3150	3300	3110	3310	3125
3300	3150	3300	3150	3300	3110	3310	3125
3300	3150	3300	3125	3300	3110	3310	3125
3300	3110	3300	3125	3300	3110	3310	3125
3300	3110	3300	3125	3300	3110	3310	3125
3300	3110	3300	3125	3300	3110	3310	3125
3300	3110	3300	3125	3300	3110	3310	3125
3300	3110	3300	3125	3300	3110	3330	3120
3300	3100	3300	3125	3300	3115	3330	3120
3300	3100	3300	3110	3325	3110	3330	3120
3300	3175	3300	3110	3325	3110	3330	3120
3300	[illegible]	3300	3100	3320	3125	3340	3140
3300	3175	3300	3100	3310	3120	3320	3140
3300	3175	3300	3100	3305	3100	3310	3130
3300	3110	3300	3100	3300	3110	3310	3130
3300	3110	3300	3100	3300	3110	3310	3130
3300	3110	3300	3100	3300	3110	3310	3130
3300	3110	3300	3100	3300	3110	3310	3130

AIRCRAFT CONFIGURATION

REPORT NO. [illegible]

[illegible] MANUFACTURING CO., 3200 PSIG RELIEF VALVE,
PART NO. A-20040, SERIAL NO. 1003

III. CYCLE TEST RESULTS

APPLIED PRESSURE (psig)	OPERATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)	CRACKING PRESSURE (psig)	RESEATING PRESSURE (psig)
3310	3110	3310	3120				
3300	3100	3310	3120				
3300	3200	3310	3100				
3300	3110	3310	3110				
3300	3110	3310	3100				
3300	3110	3310	3100				
3300	3120	3310	3100				
3300	3110	3320	3125				
3300	3120	3320	3120				
3290	3110	3320	3110				
3290	3120	3310	3120				
3290	3110	3310	3110				
3290	3110	3310	3110				
3290	3110	3310	3110				
3290	3110	3320	3120				
3290	3110	3330	3110				
3290	3110	3320	3100				
3290	3110	3320	3100				
3290	3110	3320	3100				
3290	3110	3320	3100				
3300	3125	3320	3100				
3310	3125	3320	3100				
3310	3125	3320	3100				
3300	3125	3325	3110				
3300	3125	3325	3110				
3300	3125	3325	3110				
3290	3120	3320	3125				
3300	3100	3320	3125				
3350	3100	3310	3125				
3320	3120	3310	3125				
3310	3120	3310	3115				
3300	3120	3310	3120				
3300	3120	3325	3110				
3300	3120	3300	3110				
3300	3120	3330	3100				
3320	3120	3325	3100				
3320	3120	3310	3100				
3320	3120	3320	3110				
3300	3120	3325	3100				
3300	3120	3320	3120				
3325	3125	3320	3110				
3325	3110	3310	3100				
3325	3100	3310	3100				
3310	3100	3310	3120				
3300	3100	3325	3100				
3300	3100	3325	3100				
3310	3100	3325	3120				
3310	3100	3310	3100				
3320	3100	3310	3125				
3320	3100	3310	3120				

VINSON MANUFACTURING CO., 3200 PSIG RELIEF VALVE

PART NO. A-90157-1, SERIAL NO. 1001

I. INSPECTION RESULTS

Visual inspection of this valve revealed no evidence of damage, defects, or contaminants.

II. TEMPERATURE TEST RESULTS

TEST CONDITION	CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)
I.a. Operation at room temperature (70°F).	3230 3230 3240 3240 3240 3240 3240 3240 3240	3150 3220 3080 3060 3060 3060 3210 3050 3020 3020
I.b. Operation at 0°F.	Valve leaked excessively at 2100 PSIG.	
I.c. Operation at room temperature (75°F).	3200 3210	3000 2970
I.d. Operation at 160°F.	3030 2800 2830 2820 2820	2800 2650 2750 2690 2700

VICKERS MANUFACTURING CO., 3200 PSIG RELIEF VALVE

PART NO. A-90157-1, SERIAL NO. 1001

III. CYCLE TEST RESULTS - 50 CYCLE

CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)	CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)
3230	3000	3220	2930
3230	3050	3220	2930
3230	3130	3210	2940
3230	2960	3210	2940
3220	2950	3210	2930
3220	2950	3210	2940
3220	2930	3220	2940
3210	2950	3220	2930
3220	2930	3210	2920
3220	2940	3210	2940
3210	2930	3210	2940
3210	2930	3220	2940
3220	2930	3220	2940
3220	2930	3220	2920
3230	2930	3210	2940
3210	2930	3220	2940
3210	2930	3210	2940
3220	2930	3210	2940
3210	2930	3210	2940
3210	2930	3210	2940
3210	2930	3210	2940
3220	2930	3230	2940
3220	2930	3220	2940
3220	2930	3210	2930

VINSON MANUFACTURING CO., 3200 PSIG RELIEF VALVE

PART NO. A-90157-1, SERIAL NO. 1001

IV. TEMPERATURE TEST RESULTS

TEST CONDITION	CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)
IV.a. Operation at 8°F.	Valve leaked excessively at 2000 PSIG.	
IV.b. Operation at 160°F.	3050 2800 2750 2800 2700 2780 2800 2940	2650 2550 2530 2520 2510 2520 2520 2750
Valve was returned to the manufacturer and reworked. The following tests were performed at Vinson Manufacturing Co. and witnessed by a representative from Lockheed Test Services.		
IV.c. Operation at room temperature (70°F).	3200 3250 3220	3150 3200 3160
IV.d. Operation at 160°F.	3100 3150 3110	3050 3050 3050
IV.e. Operation at 0°F.	3300 3250 3250	3200 3100 3100

VIRSON MANUFACTURING CO., 6500 PSI RELIEF VALVE

PART NO. A-90157-2, SERIAL NO. 1002

I. INSPECTION RESULTS

Visual inspection of this valve revealed no evidence of damage, defects, or contaminants.

II. TEMPERATURE TEST RESULTS

TEST CONDITION	CRACKING PRESSURE (PSIG)	RESEATING PRESSURE (PSIG)
II.a. Operation at room temperature (70°F).	6250	--
	6220	5720
	6160	5750
	6000	5700
	6000	5710
	6200*	5680
	5920	5680
	5920	5670
	6000	5590
	5890	5590
	6050	5590
II.b. Operation at 150°F.	Valve operated erratically with cracking pressure of approximately 5000 PSIG and reseating pressure of approximately 4700 PSIG.	
II.c. Operation at room temperature (70°F).	5610	5500
	5500	5700
	5800	5700
	5900	5650
	5900	5500
II.d. Operation at 0°F.	Valve leaked excessively at 1000 PSIG.	

Valve was returned to manufacturer.

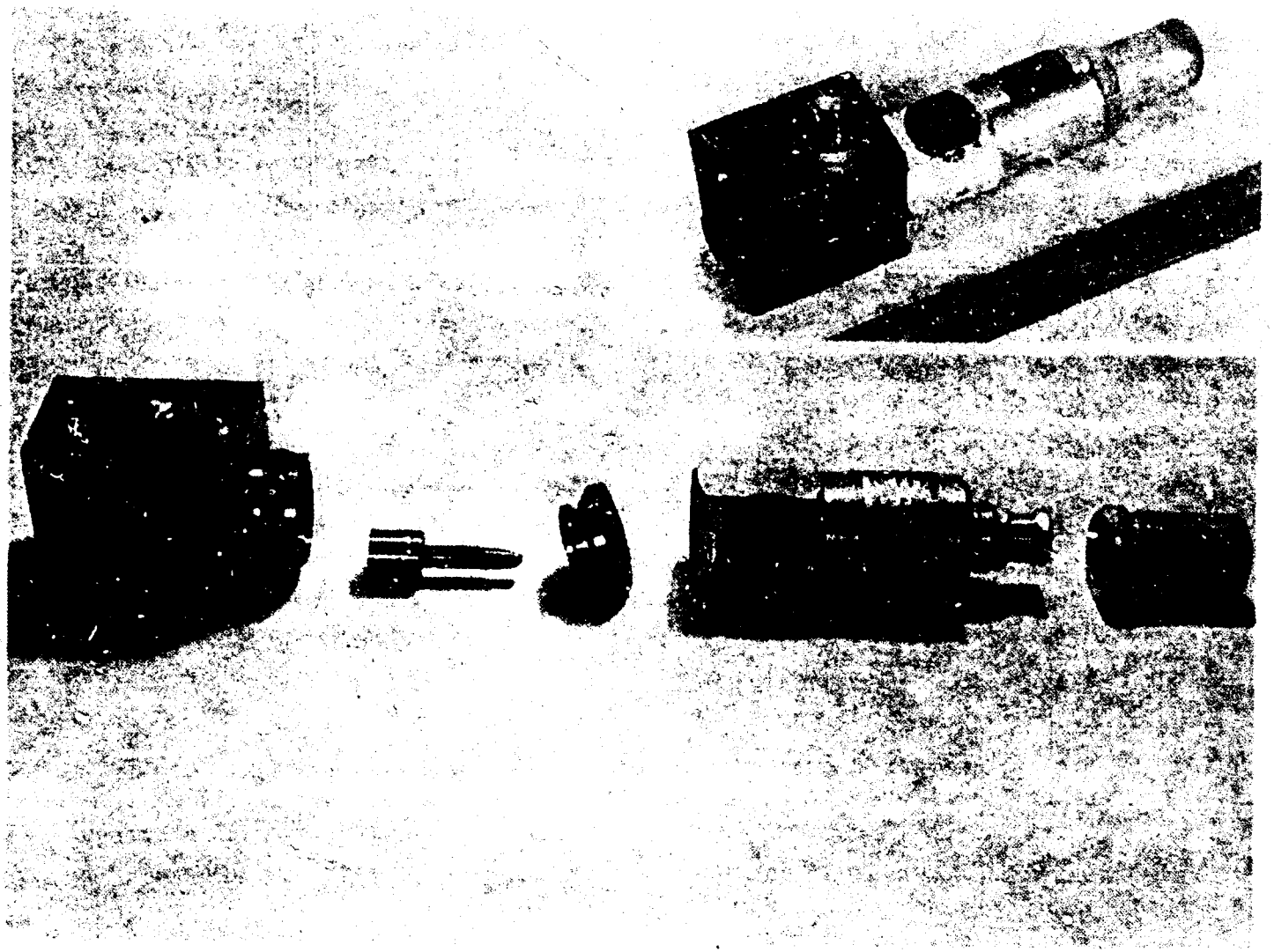

FIGURE 1. ANDERSON GREENWOOD RELIEF VALVE - TYPE 3JS16 (V27102)

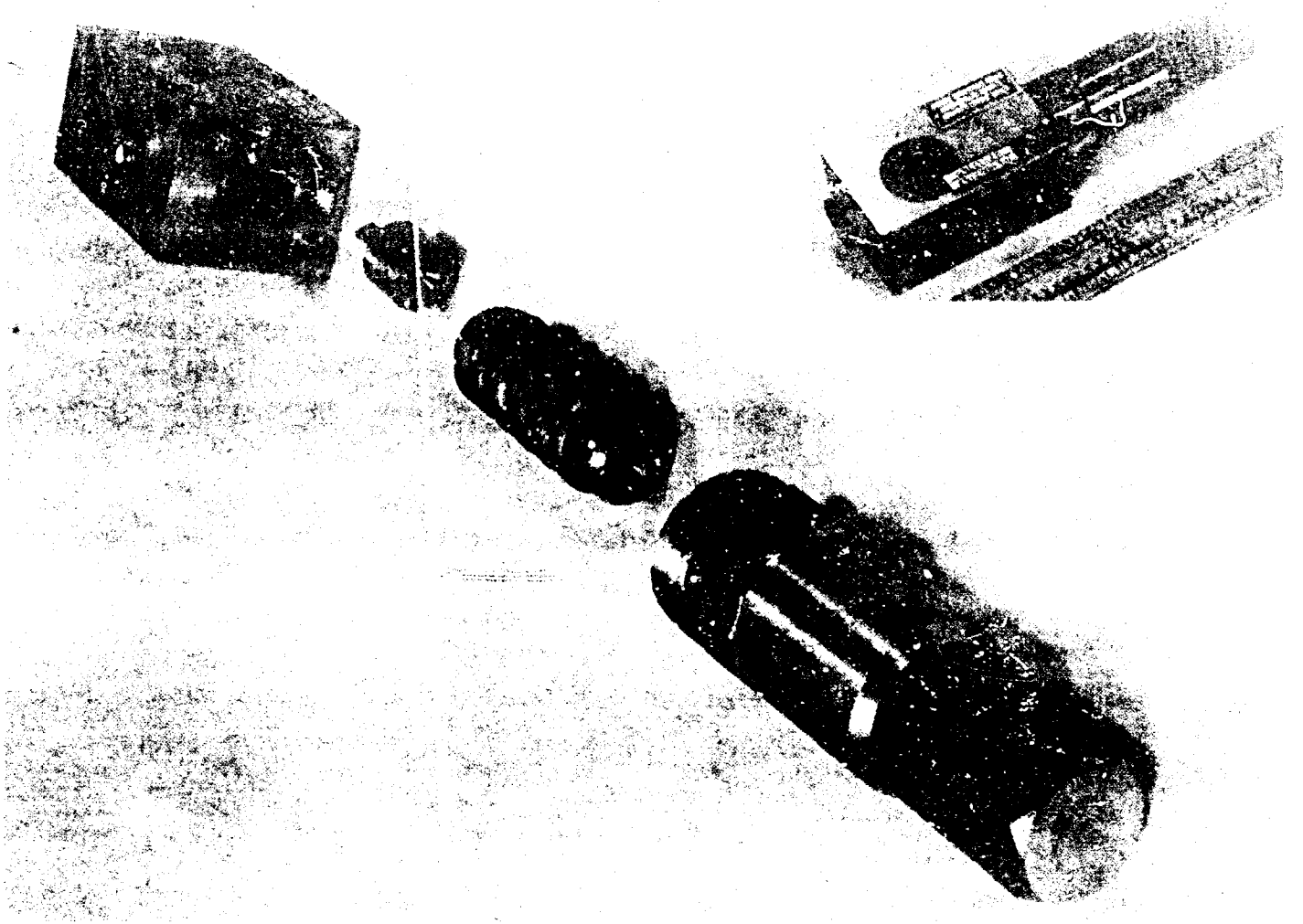

FIGURE 2. FLUID MECHANICS RELIEF VALVE - TYPE 44 TO 8 SP (V2[illegible])

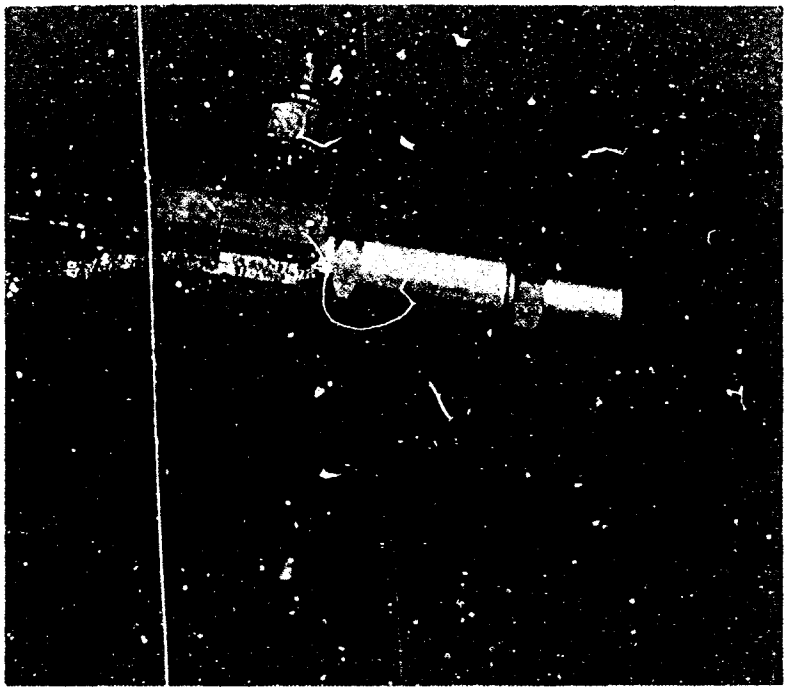

FIGURE 3. LADEWIG RELIEF VALVE - TYPE 154 S (V38153)

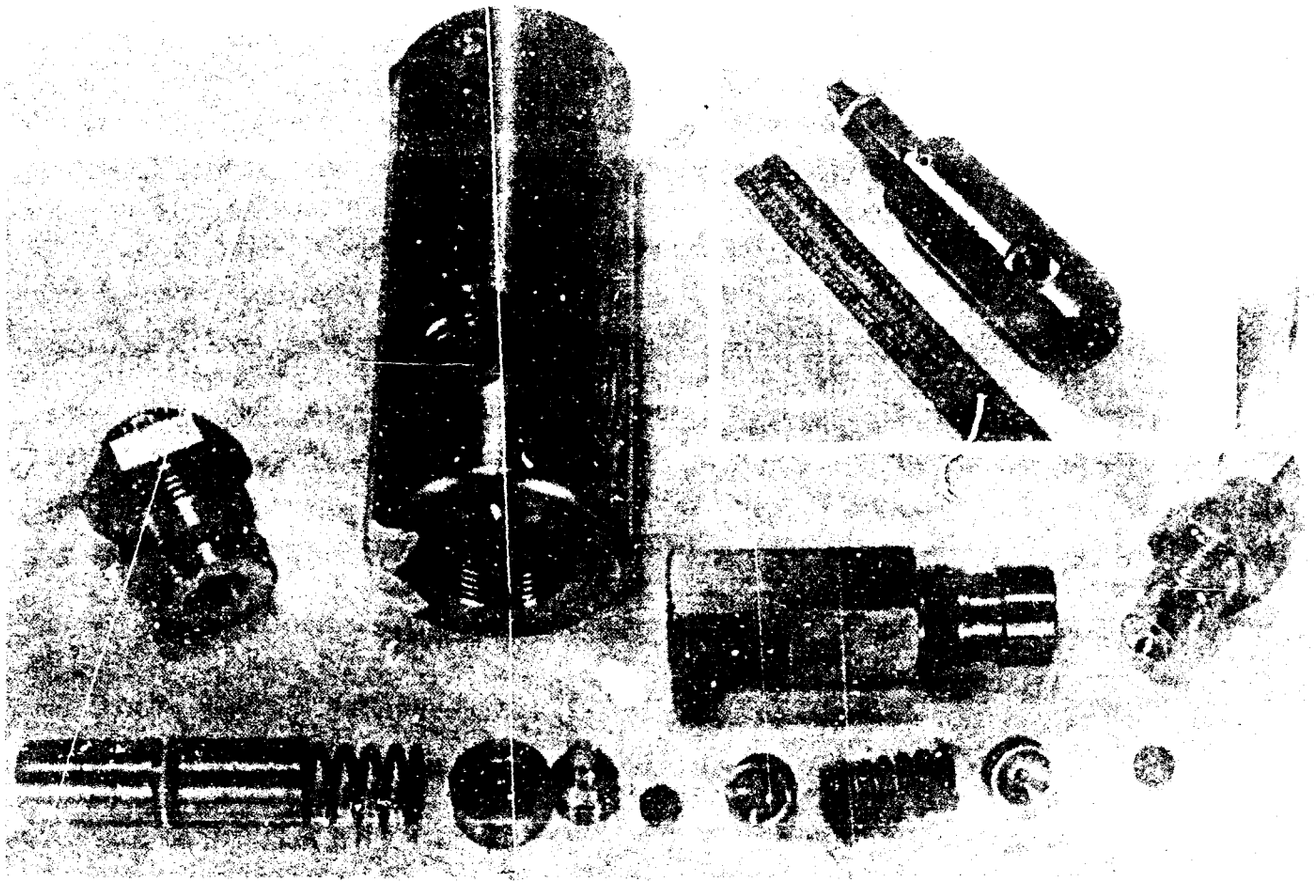

FIGURE 4. VACCO RELIEF VALVE - TYPE RV90-LP-L03 (V2(0)2)

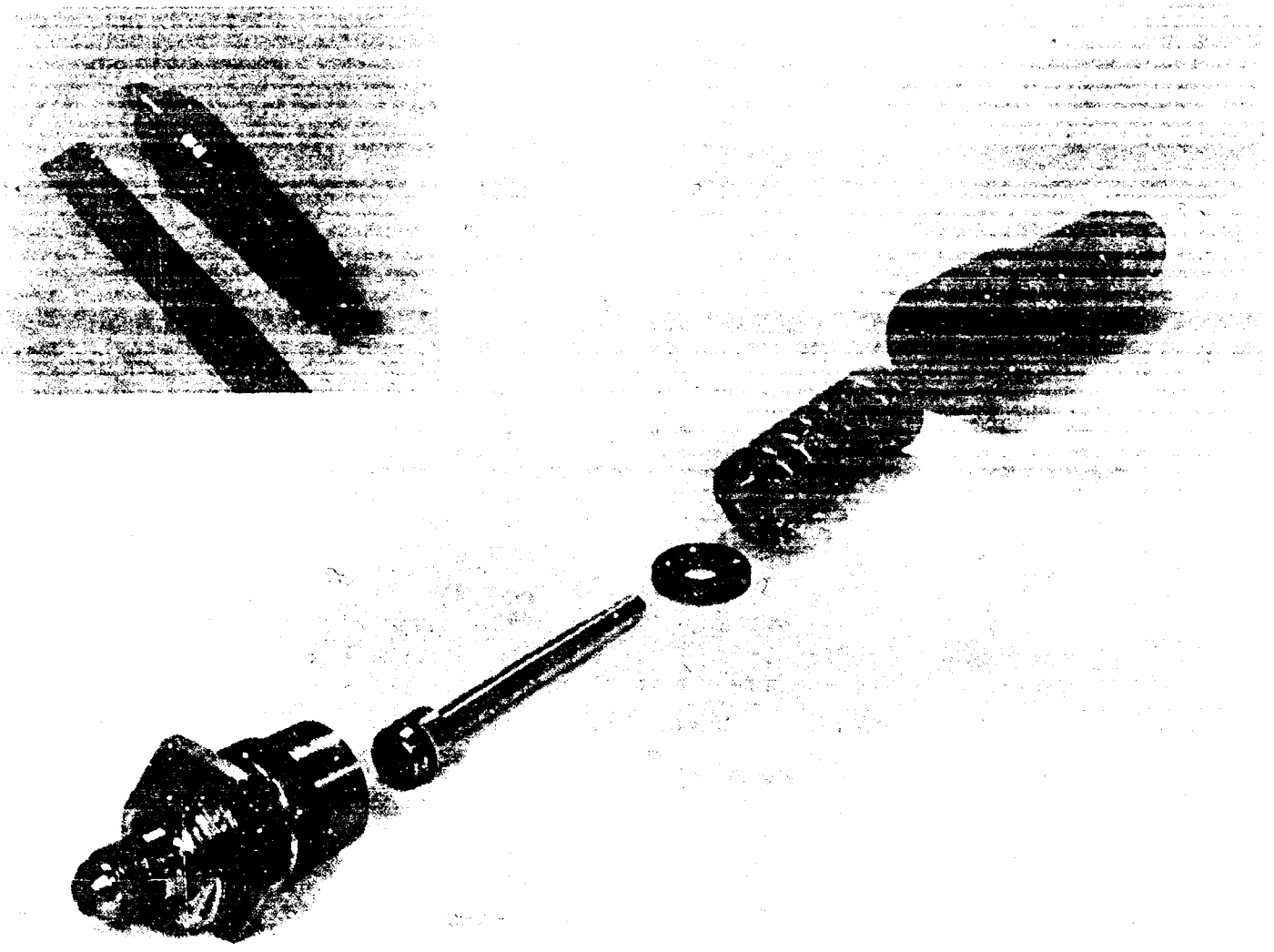

FIGURE 5. VINSON RELIEF VALVE - TYPE A-SCALE (

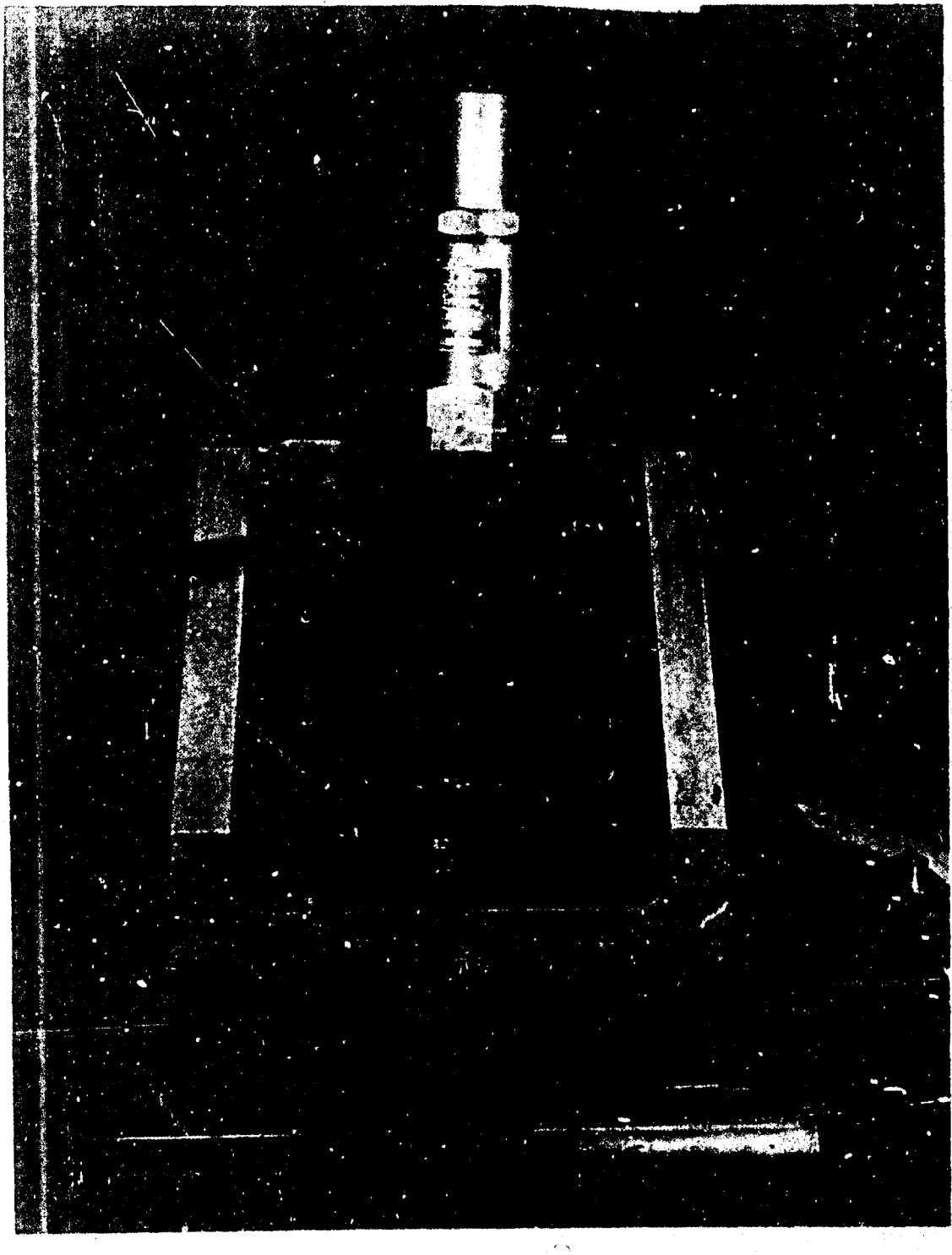

FIGURE 6. TEST INSTALLATION FOR VIBRATION PARALLEL TO THE AXIS OF THE POPPET AND SPRING.
ANDERSON GREENWOOD 3200 PSIG RELIEF VALVE. (V27229)

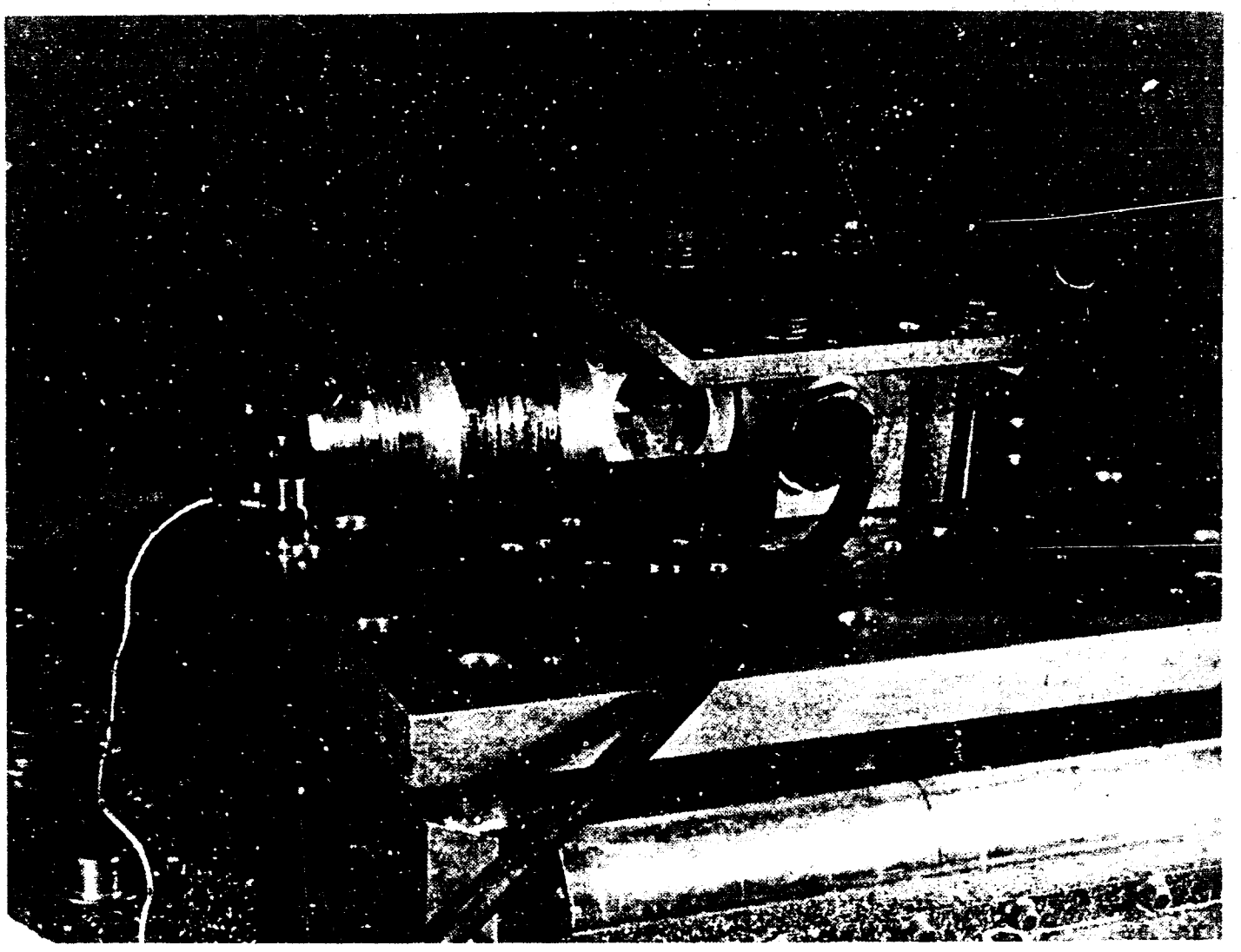

FIGURE 7. TEST INSTALLATION FOR VIBRATION PERPENDICULAR TO THE AXIS OF THE POPPET AND SPRING.

ANDERSON GREENWOOD 3200 PSIG RELIEF VALVE (V27230)

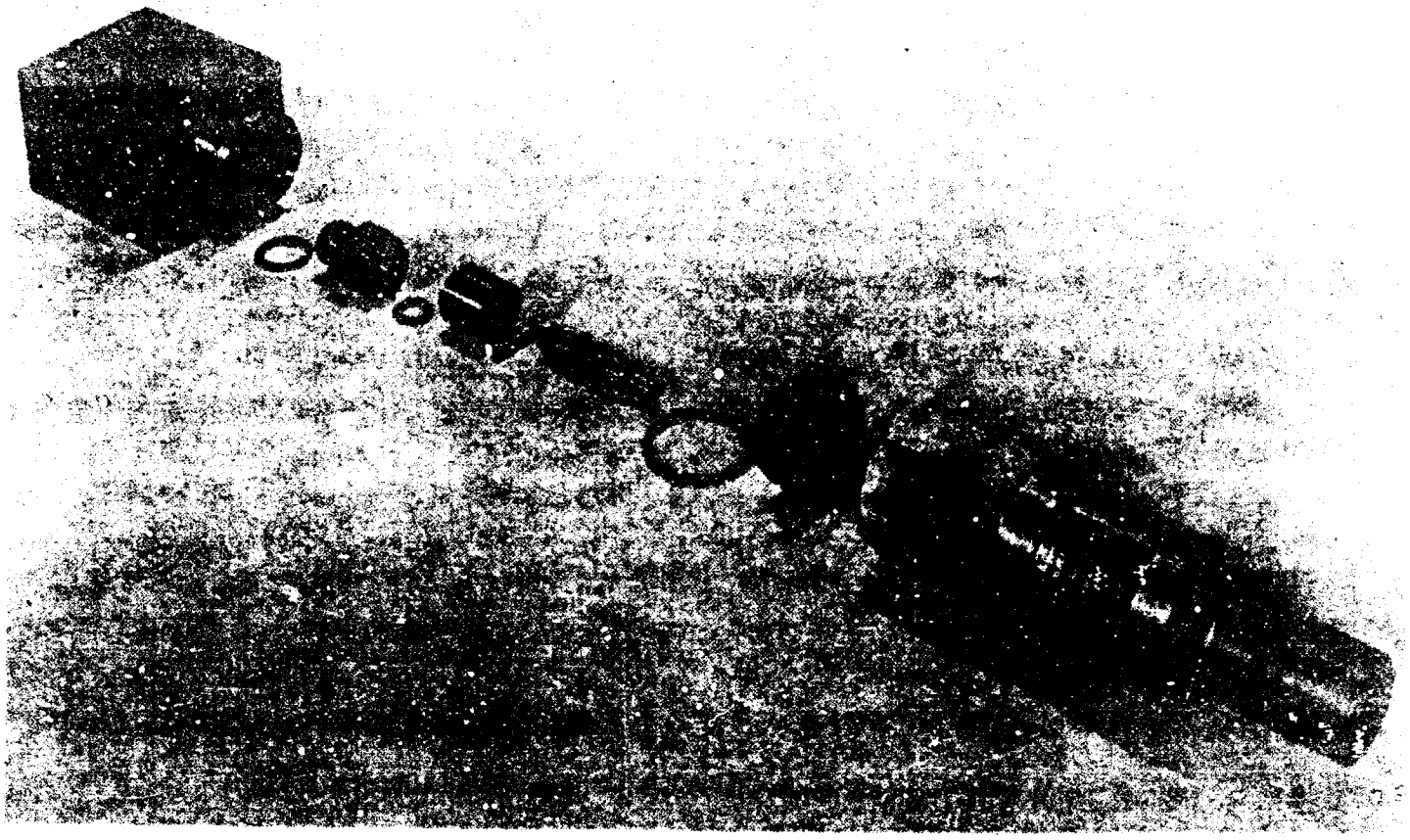

FIGURE 8. ANDERSON GREENWOOD 3200 PSIG RELIEF

DISASSEMBLED AFTER COMPLETION OF TESTING (V27676)

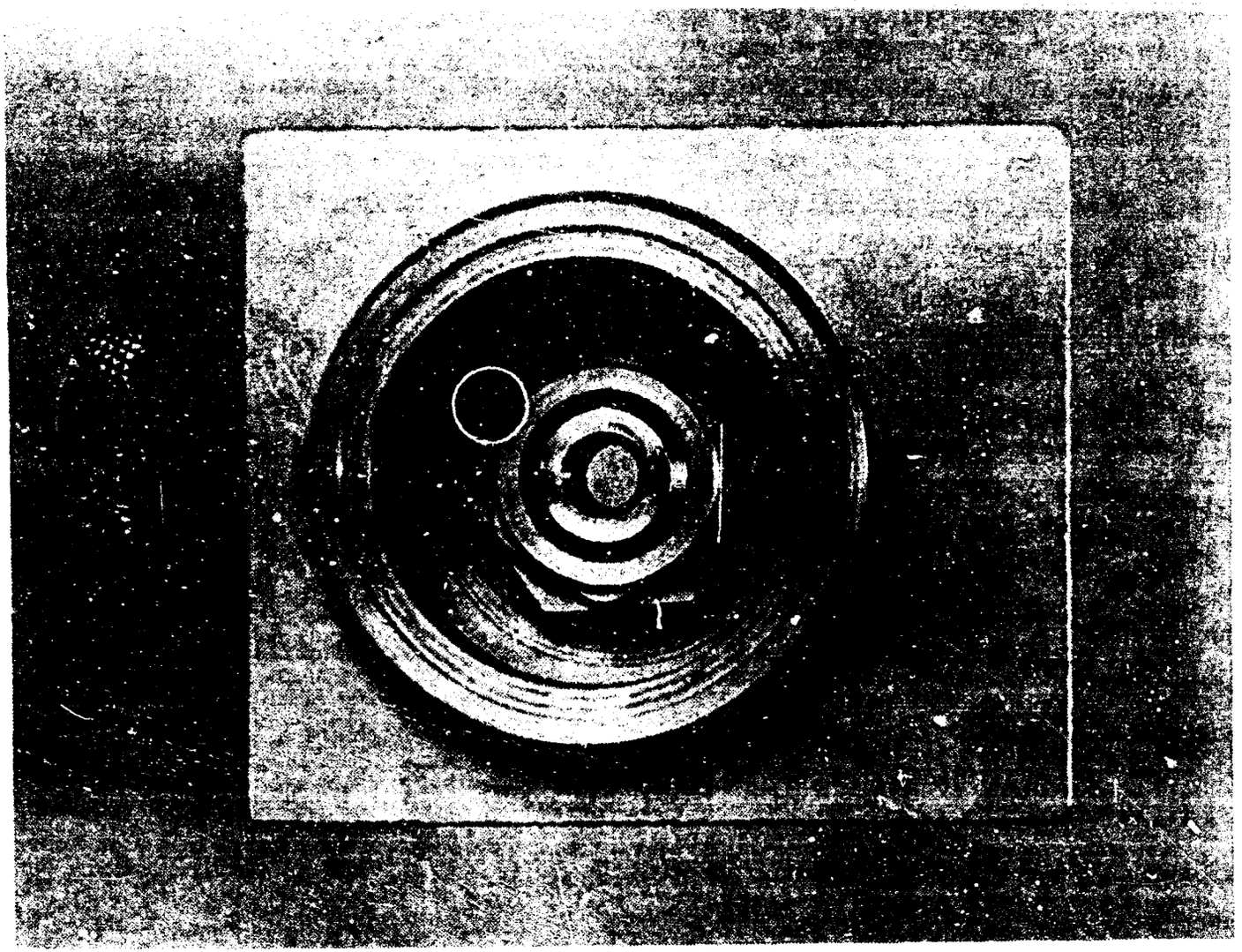

FIGURE 9. INTERIOR VIEW OF ANDERSON GREENWOOD 3200 PSIG RELIEF VALVE SHOWING PARTIALLY EXTRUDED NOZZLE SEAL (V27311)

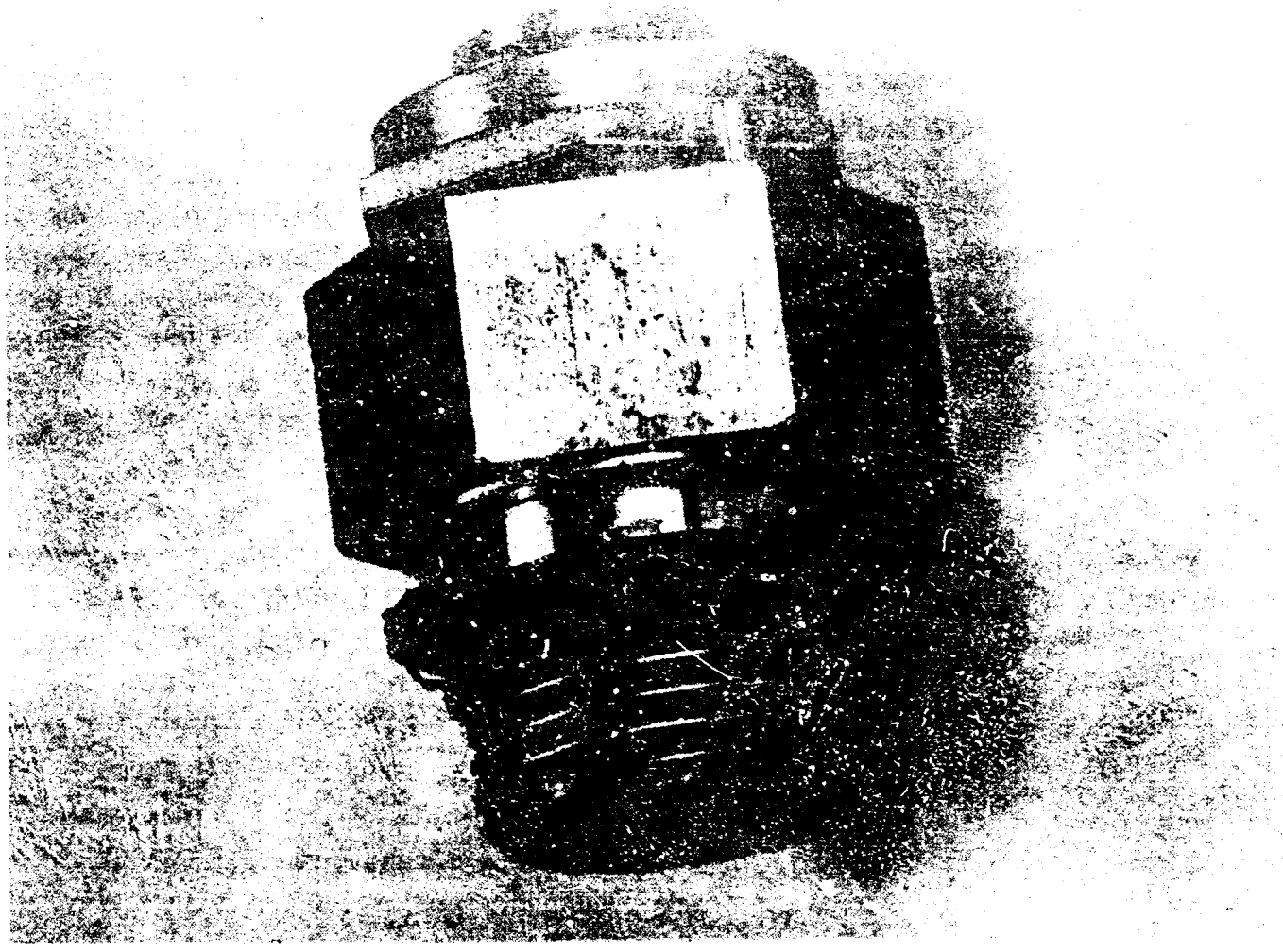

FIGURE 10. DAMAGED NOZZLE SEAL REMOVED FROM ANDERSON GREENWOOD 3200 PSIG RELIEF VALVE (M47312)

FIGURE 11. DAMAGED NOZZLE SEAL REMOVED FROM
ANDERSON GREENWOOD 6500 PSIG RELIEF VALVE (V272

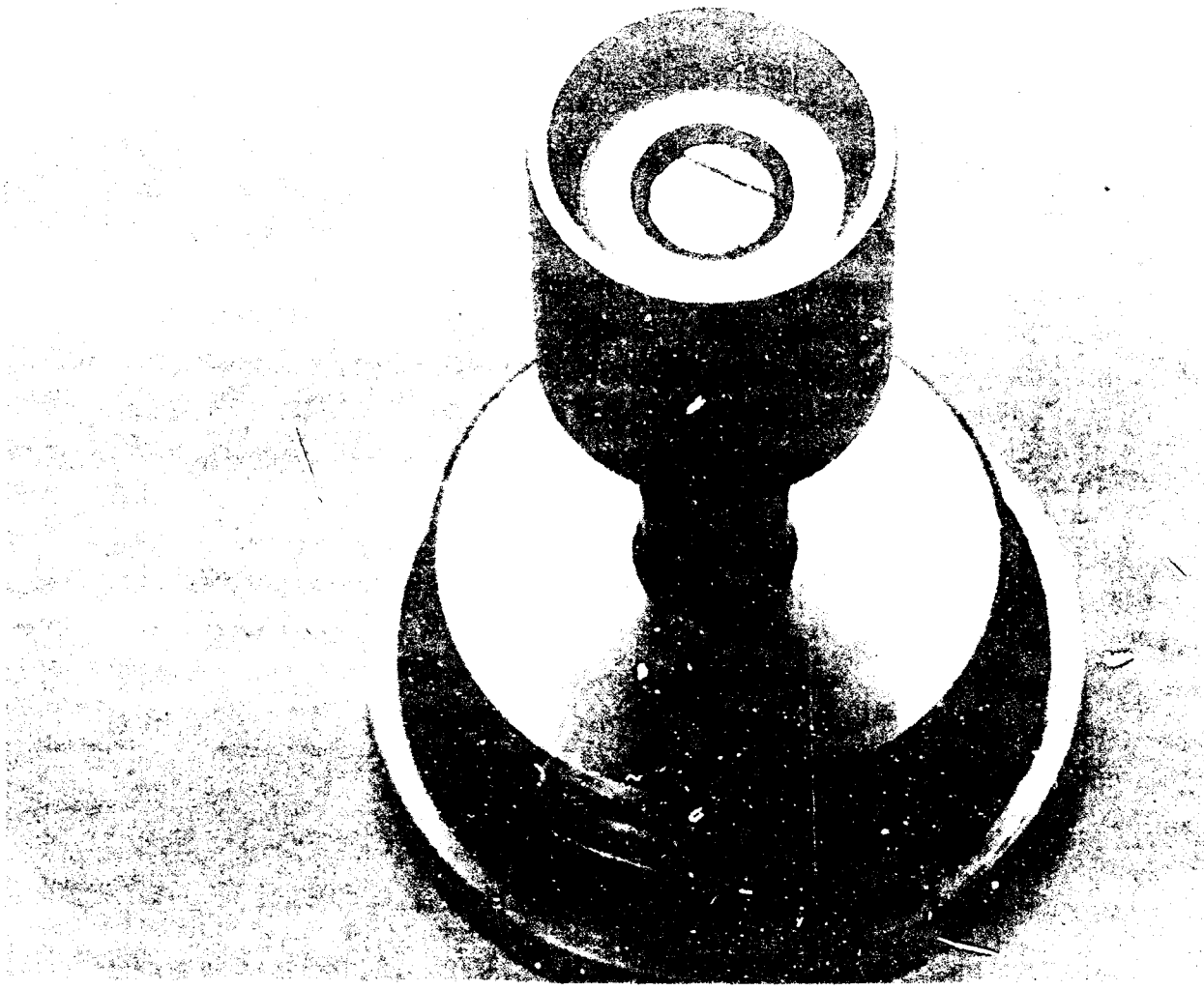

FIGURE 12. POPPET AND GUIDE FROM ANDERSON GREENWOOD 6500 PSIG RELIEF VALVE (27104)

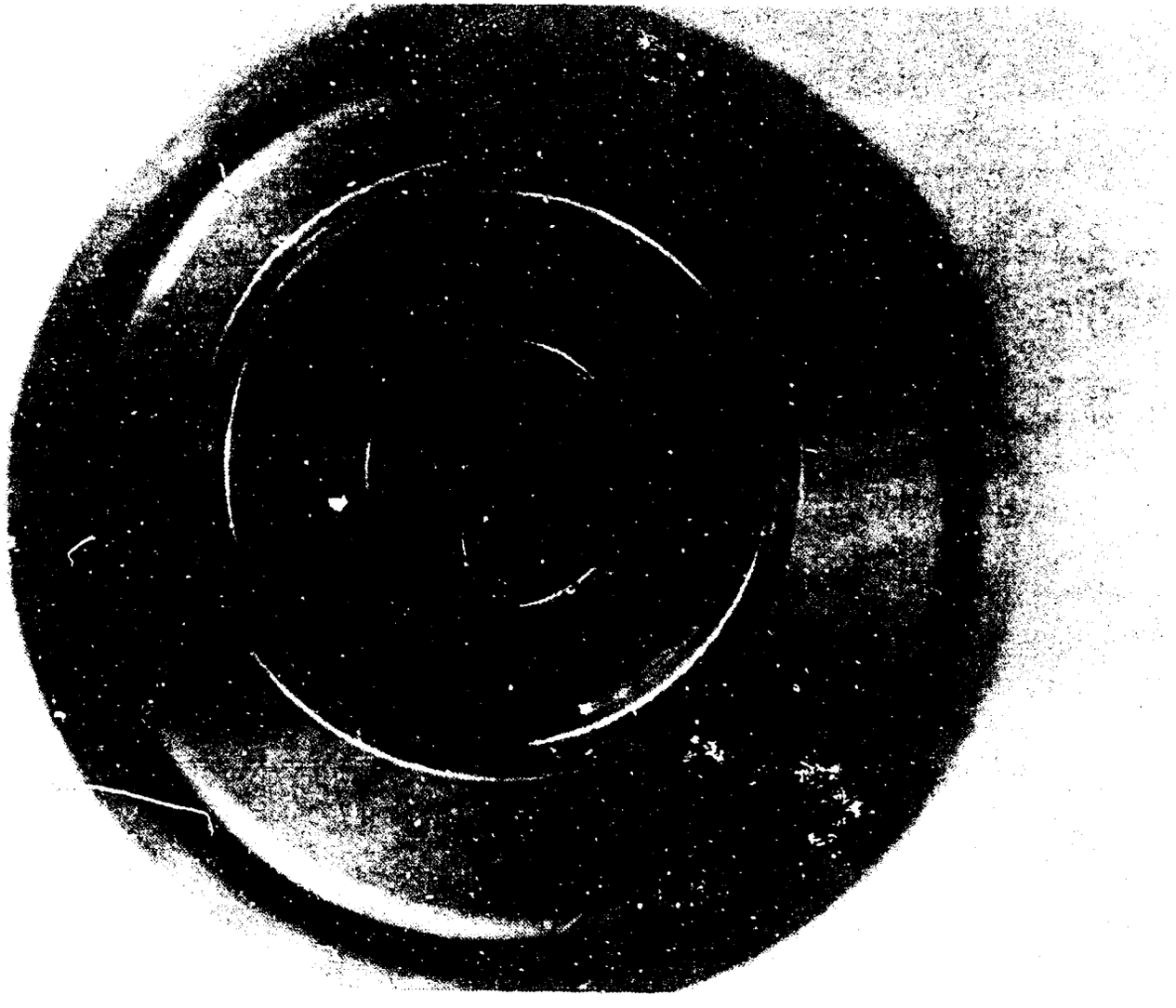

FIGURE 13. CLOSEUP OF POPPET SEAL FRACTURE (VITON-A O-RING) IN ANDERSON GREENWOOD 6500 PSIG RELIEF VALVE (V26302)